

PUBLIC SAFETY CURRICULUM AND
PROFESSIONAL DEVELOPMENT PROJECT

Environmental Technology Curriculum



Prepared by Tonya Hilligoss, M.A.

In cooperation with Golden West College

**For the Chancellor's Office,
California Community Colleges
1996**

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PROFESSIONAL DEVELOPMENT PROJECT

Environmental Technology Curriculum



**Public Safety Curriculum and
Professional Development Project**

Environmental Technology Curriculum

**Hugh Foster, Project Director
Golden West College**

**Ann Boyce, Chair
Environmental Technology/HazMat Subcommittee**

**Carl D. Perkins Vocational and Applied Technology Education
Act 1991-92
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**Tonya Hilligoss, Project Consultant
Sacramento City College
3835 Freeport Boulevard
Sacramento, CA 95822**

ACKNOWLEDGEMENTS

PROJECT DIRECTOR:

Hugh Foster, Academy Director, Golden West College, 15744 Golden West Street, Huntington Beach, CA 92647-0592

PROJECT CONSULTANT:

Tonya Hilligoss, Professor, Sacramento City College, Behavioral and Social Sciences Division, 3835 Freeport Boulevard, Sacramento, CA 95822-1386

ENVIRONMENTAL TECHNOLOGY/HAZMAT SUBCOMMITTEE CHAIR:

Ann Boyce, Associate Professor, Bakersfield College, Applied Science and Technology Department, 1801 Panorama Drive, Bakersfield, CA 93305-1299

NORTHERN CALIFORNIA COORDINATOR:

Sue Oliviera, Executive Director, South Bay Regional Public Safety Training Consortium - a joint powers agency, Evergreen Valley College, 3095 Yerba Buena Road, San Jose, CA 95135

SOUTHERN CALIFORNIA COORDINATOR:

Frank Patino, Division Dean, Department of Public Service, Rio Hondo College, 3600 Workman Mill Road, Whittier, CA 90601-1699

PROJECT COORDINATOR, STATEWIDE ADVISORY COMMITTEE FOR PUBLIC SAFETY EDUCATION:

Fred Allen, Dean of Instruction, Area I, Butte College, 3536 Butte Campus Drive, Oroville, CA 95965

COORDINATOR/PROJECT MONITOR, CHANCELLOR'S OFFICE, CALIFORNIA COMMUNITY COLLEGES:

Leo Ruelas, Ed.D., Specialist in Public Safety Education, Economic Development and Vocational Education Unit, 1107 9th Street, 9th Floor, Sacramento, CA 95814-3607

LAYOUT AND DESIGN

Allison Sekikawa, Printing Specialist, Sacramento City College, Graphic Impressions, 3835 Freeport Boulevard, Sacramento, CA 95822-1386

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Public Safety Curriculum and Professional Development Project

EXECUTIVE SUMMARY

The Public Safety Curriculum and Professional Development Project was designed to holistically address Public Safety education by updating curriculum in the separate disciplines of Correctional Science, Environmental Technology/Hazardous Materials, Fire Technology, and Law Enforcement while collectively developing solutions to the problems that they share. Project activities originated with the vision of the Statewide Advisory Committee for Public Safety Education, and project staff built on that vision to develop a model for improving Public Safety education that can be easily implemented and updated.

PROJECT ACCOMPLISHMENTS

- Programs in the four Public Safety disciplines of Correctional Science, Environmental Technology/HazMat, Fire Technology, and Law Enforcement have been thoroughly reviewed, and revisions have been made to increase their sequence and relevancy in accordance with the concepts in the SCANS Report.
- The Commission on Correctional Peace Officers Standards and Training (CPOST), the Partnership for Environmental Technology Education (PETE), the Office of the State Fire Marshal (SFM), and the Commission on Peace Officer Standards and Training (POST) have been working closely with Public Safety faculty in community colleges to develop standards for certifying courses in community colleges. Pilot certification processes are already in place for Correctional Science and Law Enforcement and are being refined in Environmental Technology and Fire Technology.
- Three new courses have been developed by Correctional Science (*Gangs and Corrections, Leadership Development in Corrections, and Supervision in Corrections*).
- Two new courses have been developed by Environmental Technology (*Hazardous Waste Management Applications and Waste Generation, Reduction and Treatment*).
- Fire Technology has updated its core and elective courses and has established standardized minimum degree requirements.
- Law Enforcement has developed and/or revised a nine-course package that incorporates the six-course CAAJE-approved core and three additional courses to house the Learning Domains constituting the cognitive coursework that a select group of community colleges is preparing to teach for POST credit on a pilot basis.
- A standardized curriculum enhancing relevancy to the occupation has been developed within each of the four Public Safety disciplines and has been approved by the primary professional organizations and certifying agencies that oversee education in each of those disciplines.
- A forty-hour Public Safety instructor development curriculum and accompanying instructor and student manuals have been completed.
- All curriculum materials have been reviewed by a gender equity/special populations consultant, and revisions have been made in accordance with recommendations. In addition, all materials were developed to conform to the requirements of Title V.
- Seven instructor development classes were held at different sites throughout California, resulting in a total of 155 Public Safety professionals who completed the course.

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- Agreements were reached with five California State University campuses to offer credit to students who completed the Public Safety instructor development course. The necessary information for securing credit for future classes is included in the Final Report.
- A final agreement has been reached with Standards and Training for Corrections (STC), and preliminary approval has been given by POST and SFM to grant agency credit to students who complete the Public Safety instructor development course. The necessary information for securing credit for future classes is included in the Final Report.
- A Public Safety Tech Prep course and video to introduce students to the relationship between community college programs, academies, and careers in Public Safety have been completed.
- Videoconferencing methodology was employed which significantly reduced costs and reduced the need for travel, thereby increasing the level of representation at any given meeting.
- Electronic bulletin boards were used to increase the effectiveness of communication efforts directed at the general Public Safety education audience.
- The project has produced a Final Report, four curriculum manuals, instructor and student manuals for the instructor development course, a compact disk containing all printed materials, and a Tech Prep videotape. All printed project materials have been pressed onto a compact disk so that they can be easily accessed in the future.
- Products developed by the project are being disseminated to all community colleges and selected state-level Public Safety agencies. Tech Prep products are also being disseminated to the County Superintendents of Education throughout California.

RECOMMENDATIONS FOR THE FUTURE

INTERDISCIPLINARY RECOMMENDATIONS

- The disciplines of Correctional Science, Environmental Technology/HazMat, Fire Technology, and Law Enforcement are encouraged to continue to coordinate educational activities under the Public Safety umbrella that enables them to share resources and expertise and to collaboratively pursue shared objectives.
- Educators within each discipline are encouraged to maintain communication regarding curriculum issues and to establish a rotational pattern on a three-year cycle that will ensure the updating of all classes.
- Educators and practitioners are encouraged to continue using videoconferencing and electronic communications technology to exchange ideas and materials in a manner that will reduce demands on time and resources.
- Educators in all four disciplines are encouraged to collaborate on the revision of similar courses so that a single course can be offered by a college to serve more than one discipline.
- Educators within each discipline are encouraged to establish a well-publicized central repository for the latest version of all curriculum materials, preferably a certifying agency or an agreed-upon professional organization when there are no certifying agencies.

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- Collaborate with certifying agencies to develop college catalogue statements regarding certification.
- Educators within each discipline are encouraged to coordinate efforts to meet the standardized numbering mandate established by the California legislature and to standardize course names at the same time.
- Colleges are encouraged to continue articulation activities between one another as new courses are developed, and to expand articulation between community colleges and four-year colleges to include all community college coursework in the area of Public Safety.
- Colleges are encouraged to continue standardization activities through the existing regional organizations that exist within the State Chancellor's Office.
- Public Safety programs in community colleges are encouraged to work with local Private Industry Councils (PICs) to promote vocational education within the public sector.
- Community colleges and high schools are encouraged to continue collaborative Tech Prep activities, including introduction of the Tech Prep materials developed by this project.
- Colleges and agencies are encouraged to utilize the students who completed the instructor development courses and the instructor development curriculum materials developed by this project to offer new courses throughout the state and to institutionalize these courses so that they are offered on a regular basis.
- Colleges and agencies offering the instructor development courses are strongly encouraged to use the materials in Appendix K to secure approval by POST, the Office of the State Fire Marshal, and individual CSU campuses so that students can receive academic and/or continuing education units for completing the course.
- Community colleges and Public Safety agencies are encouraged to coordinate activities to ensure that Public Safety education will be exempt from the enrollment cap that affects community college funding.

CORRECTIONAL SCIENCE RECOMMENDATIONS

- Continue the collaboration between the California community colleges, the Commission on Correctional Peace Officers Standards and Training, the California Department of Corrections, the California Youth Authority, the California Correctional Peace Officers Association, and the Commission on Standards and Training of the Board of Corrections to promote the development and updating of Correctional Science classes and the integration of correctional education into the hiring and promotional process.
- Establish a rotational pattern on a three-year cycle that will ensure the updating of all classes.
- Collaborate with the Commission on Correctional Peace Officer Standards and Training to develop criteria for faculty teaching correctional classes so that all classes are taught by instructors with applied experience in correctional settings.
- Utilize videoconferencing and electronic communication options to provide for the participation of Corrections professionals throughout California for both interagency and interinstitutional discussions and in the presentation of Correctional Science education opportunities.

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- Develop pilot projects to attract pre-service candidates to correctional careers.
- Collaborate with high school Tech Prep programs to encourage students to pursue careers in the field of Corrections.

ENVIRONMENTAL TECHNOLOGY RECOMMENDATIONS

- Immediately update the four curriculum outlines that were last reviewed in 1990.
- Establish a rotational pattern on a three-year cycle that will ensure the regular updating of all classes.
- Promote the standardization of Environmental Technology classes by developing standardized tests to be used in all classes.
- Continually add to those tests to provide an extensive bank of potential test questions.
- Explore the possibility of establishing an accreditation process through the Partnership for Environmental Technology Education (PETE), a national professional organization.
- Collaborate with high school Tech Prep programs to promote careers in Environmental Technology.

FIRE TECHNOLOGY RECOMMENDATIONS

- Continue negotiations between the Office of the State Fire Marshal and the California Fire Directors Association to establish a mutually agreed upon accreditation process.
- Continue the collaboration between the community colleges and the California State University system to establish an articulation process that provides a seamless transition from community colleges to four-year colleges.
- Establish a rotational pattern on a three-year cycle that will ensure the regular updating of all classes.
- Utilize videoconferencing and electronic communication options to provide for the wide representation of Fire Technology educators in ongoing discussions to address training needs, which will produce a dramatic reduction in cost and improve educational efficiency.
- Collaborate with high school Tech Prep programs to promote fire service careers.
- Collaborate with the Office of the State Fire Marshal to develop a college catalog statement regarding fire service training standards for community college programs that meet SFM standards.

LAW ENFORCEMENT RECOMMENDATIONS

- Continue the collaboration between the California community colleges, Law Enforcement academies, hiring agencies, four-year colleges, the California Association of Administration of Justice Educators (CAAJE), the California Academy Directors Association (CADA), and the Commission on Peace Officer Standards and Training (POST) to promote the development and updating of Law Enforcement curriculum materials.
- Establish a rotational pattern on a three-year cycle that will ensure the updating of all classes.
- Establish standards for each class to ensure that it will only be taught by those faculty members with the applied experience necessary to teach that subject matter.

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- Encourage ongoing classroom and field training for Law Enforcement faculty to keep them updated on new procedures, policies, and technologies.
- Utilize videoconferencing, e-mail, and the CAAJE Internet web page and chatroom to provide for the participation of Law Enforcement professionals throughout California in ongoing discussions about education in the field of Law Enforcement.
- Develop pilot projects to attract pre-service candidates to Law Enforcement careers.
- Collaborate with high school Tech Prep programs to encourage students to pursue careers in the field of Law Enforcement.
- Develop Code Enforcement and Security courses for students who do not pursue other careers in Public Safety.

SPECIFIC RECOMMENDATIONS FOR THE IMMEDIATE FUTURE

As the organizational link for all four Public Safety disciplines, the Statewide Advisory Committee for Public Safety Education needs to coordinate the following educational activities*:

- Build on the recently strengthened collaborative relationships between community colleges, certifying agencies, and hiring agencies to update three classes within each discipline and integrate Public Safety education into the hiring and promotional process. (*Projected budget: \$24,000*)
- Within each discipline, create regularly-updated web pages from which curriculum materials can be downloaded and chat rooms in which ongoing curriculum discussions can be held. (*Projected budget: \$8,000*)
- Build on the collaborative relationships between the four Public Safety disciplines to revise similar courses within disciplines (Report Writing; Concepts of Law) and to develop one new course (Supervision) so that a single course can be offered in any given subject area that will serve multiple disciplines. (*Projected budget: \$12,000*)
- Within each discipline, coordinate efforts to meet the standardized numbering system mandate established by the California legislature and standardize course names at the same time. (*Projected budget: \$6,000*)
- Oversee the institutionalization of the Public Safety Instructor Development course throughout the state by offering six classes and refining the instructor and student manuals developed for this project. (*Projected budget: \$94,000 [\$15,000/class for two instructors/class, student and instructor travel, and coordination activities; \$4,000 for manual revisions]*)
- Collaborate with high school Tech Prep programs to develop a transition class from high school to college for each of the four Public Safety disciplines. (*Projected budget: \$16,000*)

* *Costs include travel and coordination.*

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- Collaborate with hiring agencies to develop a model internship program within each discipline that will more effectively integrate coursework with applied experience. (*Projected budget: \$12,000*)
- Establish and conduct an ongoing program review and presentation of all Public Safety programs. This initiation could be implemented by the Statewide Advisory Committee for Public Safety Education. (*Projected budget: \$28,000*)

TOTAL: \$200,000

CHAPTER 1

INTRODUCTION

The Public Safety Curriculum and Professional Development Project was initiated by the Statewide Advisory Committee for Public Safety Education to better utilize existing training resources in a manner that would make Public Safety education more responsive to the needs of hiring agencies. At the same time, it was designed to provide students with a broader education that would better meet their professional needs as well as those of the public with whom they would work. The findings of the Public Safety Curriculum Project, published in 1992, conclusively demonstrated that the four Public Safety disciplines (Corrections, Environmental Technology/Hazardous Materials, Fire Technology, and Law Enforcement) shared far more in common than had been previously recognized. They all require very specific technical training and the interpersonal skills necessary to serve the public in crisis situations and, since all four disciplines prepare students for identified careers with specific training guidelines, they share a need for a standardized curriculum that hiring agencies can rely on being taught in all programs throughout the state. However, because they also prepare students to work with the public, that curriculum must include the exposure to new ideas, situations, and human variation that will enable students to develop the emotional and intellectual maturity required to work with people in crisis situations. Given those similarities, it became clear that certain aspects of Public Safety education could be shared among all four disciplines, thereby permitting the more efficient utilization of the public resources upon which they all rely.

This project has addressed two major objectives: 1) the development of an updated, industry-relevant curriculum that serves all segments of the student population at the academy, community college, and four-year college levels in a well-articulated manner, and 2) the delivery of short-term instructor development education throughout the state. Both objectives have been met and exceeded as it became evident that merely achieving the stated goals would not satisfy the underlying needs of Public Safety education. In response to that realization, the project took responsibility for the following additional activities: 1) development and dissemination of a Public Safety Tech Prep (high school) overview course and videotape, 2) development of curriculum materials for the POST (Commission on Peace Officer Standards and Training) Transition Pilot Project, 3) development of a Public Safety Instructor Development course and the instructor and student manuals that will enable the course to be taught beyond the expiration of this project, and 4) production of compact disks in both Macintosh and IBM-compatible formats that contain the final report for this project, the entire curriculum for each of the four disciplines, the instructor and student manuals for the Public Safety Instructor Development course, and supplementary materials that will be disseminated to every community college in California. We are suggesting that it be catalogued and shelved in either the Library or the Learning Resources Center at each college so that it can be easily accessed by Public Safety faculty throughout the state.

Public Safety education is dependent on more than its curriculum and instructional delivery models, so this project also addressed accountability. Statewide Management Information System (MIS) data is designed to help programs determine their level of effectiveness, and this project attempted to utilize that data to evaluate its programs. However, during the first year of the project it became obvious that the figures did not correspond with the observations and experiences of public safety faculty and Public Safety Center directors. One problem appeared to be the result of some colleges not reporting all certificate completions, while a second problem was duplicated counts whereby students in academies were being counted more than once when they took more than one class. That resulted in an unrealistically low completion rate. Letters describing the problems were sent to all colleges in August 1995 with a request that they be addressed. Data is not yet available to determine whether they have been, but the issue clearly needs to remain in the forefront until it is resolved.

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A second accountability matter is that of tracking students who complete Public Safety programs. Colleges do not have access to a means of tracking students through personal identification data, and students have historically been difficult to track any other way. Although the Public Safety data is not yet available, the State Chancellor's Office is in the process of including Public Safety in the Employment Development Department project that will give community colleges access to wage unemployment insurance data in aggregate form. That will be invaluable in assessing the number of students in Public Safety programs who secure employment in their field of study.

Accountability, curriculum development, and instructor development are all essential elements of vocational education. Although accountability tools are still in the process of being developed, curriculum materials completed for this project can be found in separate documents being disseminated with the Final Report. Information related to those materials is located in the chapters that follow.

CHAPTER 2

OVERVIEW OF CURRICULUM

In accordance with the concepts in the U. S. Labor Department’s SCANS Report, each of the four Public Safety disciplines has developed an industry-relevant curriculum designed to standardize Public Safety education throughout California. However, in response to the concern for academic freedom expressed by college faculty, the prescribed elements of the coursework leave time within a standard three-unit course for the inclusion of other information as determined by each instructor. Previous attempts to standardize Public Safety education have suffered from the lack of a certification process to ensure adoption and implementation of the approved curriculum, so efforts have been made to develop a process within each discipline that will encourage that to take place. Those efforts have been partially realized at this point, and are continuing with the intent by all parties that they be completed. It has already been established that Corrections courses will be certified by CPOST (the Commission on Correctional Peace Officers Standards and Training), and that Law Enforcement courses in colleges participating in the POST Transition Pilot Project will be certified by the Commission on Peace Officer Standards and Training (POST). Fire Technology educators have been working with the Office of the State Fire Marshal to develop a certification process, while Environmental Technology educators are exploring the possibility of pursuing an accreditation process through the Partnership for Environmental Technology Education (PETE), a national professional organization. Law Enforcement programs not currently in the POST Transition Pilot Project are not yet certified by POST, but they are encouraged to adopt certified courses so that they will have them in place if the pilot project is expanded to include all Administration of Justice programs. In addition to certification by Public Safety agencies, the curriculum for each discipline has also been submitted to campus curriculum committees for approval. This process precedes submission of the curriculum to the State Chancellor’s Office.

The curriculum for each discipline is located in a separate document along with the relevant supplementary materials. The exceptions are the course outline and the sample lesson plan for the course entitled “Multicultural Issues Within Public Safety” and the course outline for “Theory and Concepts of Contemporary Public Safety,” which are located in Appendices D, E and F of the final report. These materials are located centrally due to the fact that they apply to all four disciplines. Similarly, the oral and communication curriculum materials are located in Appendix G of the final report because they can serve as supplementary materials for several classes in each of the disciplines. It should also be noted that “Multicultural Issues Within Public Safety” was developed to satisfy the American Cultures requirement at the University of California, Berkeley, which qualifies it to meet the multicultural graduation requirement at most, if not all, of California’s colleges and universities. Approval of courses to meet that requirement are granted to individual instructors teaching specified courses, so instructors at each college will need to apply individually to the Subcommittee on the Breadth Requirement in American Cultures at UC Berkeley. The author of the course can be contacted for assistance in this process. Educators are encouraged to develop cross-disciplinary coursework whenever possible so that colleges can offer one course that will serve several disciplines. Both Correctional Science and Law Enforcement offer courses entitled “Concepts of Law,” while it is conceivable that a single course could meet the requirements of both programs. It might even be possible to develop a generic course in report writing that would incorporate different assignments based on the program in which each student was enrolled. Supervision courses offer another opportunity to pursue this option. It would be prudent to consider developing cross-disciplinary coursework whenever there is a danger that a single program cannot support all the courses required for a major.

Each of the courses developed has been reviewed by a consultant to ensure that they address gender equity and special populations concerns, and suggested revisions have been implemented throughout the curriculum. In addition, Title V guidelines were applied to the development of coursework, and a sampling of textbooks was assessed for reading level (Appendix J in the final report).

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CHAPTER 3

OVERVIEW OF TECH PREP ACTIVITIES

As the need for well-trained Public Safety professionals grows, recruitment becomes increasingly more critical. As this project progressed, it became apparent that there is a need to familiarize high school students with career opportunities in Public Safety so that they can begin to make life choices that are consistent with those careers. The “Theory and Concepts of Contemporary Public Safety” course that was developed as part of the 1993 Public Safety Curriculum Project was originally designed as an overview course for college students considering careers in Public Safety. However, given the number of applicants who are ineligible to pursue these careers because of illicit activities engaged in prior to becoming adults, it seemed more appropriate to introduce that course into the high school curriculum. The course outline is included in Appendix F of the final report. The project also developed a ten-minute videotape entitled “Project: Fast Forward” which introduces students to the opportunities for taking community college classes to gain a head start on academy training. The Tech Prep course outline and videotape are being sent to the Superintendent of Schools in each county as well as to each of California’s community colleges with the recommendation that they work as a team to help prepare students for Public Safety careers.

CHAPTER 4

OVERVIEW OF INSTRUCTOR DEVELOPMENT COURSE

One of the objectives of the Public Safety Curriculum and Professional Development Project was to provide instructor development instruction to faculty teaching Public Safety courses. In April of 1995 courses were presented at Evergreen Valley College (San Jose) and Rio Hondo College (Whittier) incorporating a pre-established curriculum used by law enforcement. Although it is an excellent instructor development curriculum, it was designed specifically for law enforcement, and it became obvious that there was a need for a generic curriculum that is designed to address the educational needs of all four Public Safety disciplines as well as the needs of both college and academy instructors. Since that time, a concerted effort has been made to develop that curriculum.

The feedback from students in the seven pilot classes provided direction that resulted in major revisions of the curriculum after the first two classes. The final two classes taught in April 1996 provided validation that the earlier revisions had addressed student needs, so only minor changes were made after those classes. The instructor’s manual was developed to provide all the material necessary along with a step-by-step guide to teach the forty-hour instructor development class. However, it is strongly recommended that any agency or college introducing this class first have it taught by a team of instructors who have completed the training. Instructor development is far more complicated than what most manuals address, so even the most comprehensive manual cannot possibly convey everything that an instructor should ideally know. However, those students who completed the course experienced the nuances that cannot be included in a manual, and they are in an excellent position to train the trainers in other organizations. Recent court decisions have made it quite clear that organizations providing Public Safety instruction are legally liable when that instruction is not properly delivered, so training the trainers must be recognized as a priority for any organization.

Because the curriculum changed significantly from class to class, those who completed the most recent classes have obviously been exposed to the most recent versions of the curriculum. However, master-level instructors who completed any of the classes and who have familiarized themselves with the Instructor’s Manual are likely to be able to effectively teach this class. We strongly recommend that instructors’ prior teaching experience be

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evaluated along with information regarding their completion of this class when selecting instructors for future classes. We also recommend that these classes be taught by a team of two instructors for a class of 25-30 students. This curriculum is very intensive and highly interactive, so two instructors are needed to ensure that the activities responsible for effective learning are equally experienced by everyone in the class. If there are any questions, Tonie Hilligoss has complete records on all the courses that were taught as part of this project. She can be reached at (916) 288-0508.

This course has already been approved by Standards and Training for Corrections (STC), and the final version is being reviewed by POST and the Office of the State Fire Marshal. In addition, it has been approved for continuing education units (CEUs) by four California State University campuses and was approved for academic units by California State University, Sonoma. CSU credit must be granted by the campus that serves any given community, and organizations offering the class are encouraged to submit the completed expanded course outline to the closest campus for academic credit. This is a fairly lengthy process for the CSU system, so it would be best to do it as soon as possible. All the information necessary is located in the STC document in Appendix K of the final report.

Different versions of this class have been completed by 155 instructors throughout California representing the four Public Safety disciplines of Corrections, Environmental Technology/HazMat, Fire Technology, and Law Enforcement. They are listed by the location of the class they completed, and the classes are listed in inverse chronological order, with the most recent first. Please note that the time frames reflect that during three instructional periods, two classes were taught at the same time: San Jose and Whittier, Sacramento and San Diego, and Concord and Merced. The courses within each time frame are listed in alphabetical order.

CHAPTER 5

RECOMMENDATIONS AND CONCLUSION

One of the primary results of this project has been the establishment of a strong collaborative relationship between the four Public Safety disciplines. Events in recent years have brought attention to the crucial role played by Public Safety education, and educators and practitioners from the four disciplines have worked together to respond to that. Specifically, this project has standardized the curriculum within each discipline and developed a generic Public Safety instructor development curriculum designed to strengthen the delivery of all Public Safety education. In the process, strategies for eliminating some of the barriers to ongoing curriculum development have been developed. The necessary communication essential to a strong educational program in any field is often limited by the time and money that interested parties have available. This project significantly reduced the need for travel by utilizing videoconferencing technology and has been assured that the California State University system is willing to continue making its facilities available for Public Safety education purposes at nominal cost (\$100-\$200/hour) in locations unserved by the community college system that is in the process of being completed. The project also developed an information distribution model that incorporates the use of electronic bulletin boards available to educators and Public Safety professionals. To promote continued advancements in the field of Public Safety education, the 1994 - 1996 Public Safety Curriculum and Professional Development Project makes the following recommendations:

- the disciplines of Correctional Science, Environmental Technology/HazMat, Fire Technology, and Law Enforcement are encouraged to continue to coordinate educational activities under the Public Safety umbrella that enables them to share resources and expertise and to collaboratively pursue shared objectives

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- educators within each discipline are encouraged to maintain communication regarding curriculum issues and to establish a rotational pattern on a three-year cycle that will ensure the updating of all classes
- educators and practitioners are encouraged to continue using videoconferencing and electronic communications technology to exchange ideas and materials in a manner that will reduce demands on time and resources
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- educators within each discipline are encouraged to establish a well-publicized central repository for the latest version of all curriculum materials, preferably a certifying agency or an agreed-upon professional organization if there are no certifying agencies
- individual colleges are encouraged to collaborate with certifying agencies to develop college catalogue statements regarding certification
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- colleges and agencies offering the instructor development courses are strongly encouraged to use the materials in Appendix K to secure approval by POST, the Office of the State Fire Marshal, and individual CSU campuses so that students can receive academic and/or continuing education units for completing the course
- community colleges and Public Safety agencies are encouraged to coordinate activities to ensure that Public Safety education will be exempt from the enrollment cap that affects community college funding

Public safety educators throughout California have been working closely with Public Safety practitioners to develop a curriculum and a training delivery system that will best prepare students for some of society's most challenging careers. Through their involvement in the Statewide Advisory Committee for Public Safety Education, professional organizations, and projects such as this one, they have made significant progress towards refining Public Safety education so that it meets the guidelines established in the SCANS Report. The recommendations listed above will further this effort in very specific ways that will help ensure that reform in the field of Public Safety education is a continuing activity.

APPENDIX A
STEERING COMMITTEE MEMBERS

Public Safety Curriculum and Professional Development Project

STEERING COMMITTEE MEMBERS

Project Staff

Hugh Foster, Golden West College - Project Director
Tonya Hilligoss, Sacramento City College - Project Consultant
Sue Oliviera, South Bay Regional Public Safety Training Consortium - Northern California Coordinator
Frank Patino, Rio Hondo College - Southern California Coordinator

Subcommittee Chairs

Correctional Science - Jan Hayes - Project Officer, Correctional Science Curriculum Project - Merced College
Environmental Technology/HazMat - Ann Boyce - HazMat representative to the Statewide Advisory Committee for Public Safety Education - Bakersfield College
Fire Technology - Bill Lane - Past-President, California Fire Technology Directors Association - Allan Hancock College (ret.)
Law Enforcement - Fred Allen - Dean of Instruction, Butte College/Project Coordinator, Statewide Advisory Committee for Public Safety Education

Members

Ron Allen - POST - Chief, Training Deliverance and Compliance
Chris Almeida - K-12 Tech Prep representative, California Department of Education
Armand Burrue - California Department of Corrections representative to the Statewide Advisory Committee for Public Safety Education - Human Resources Development Office, CDC
Art Cota - Division Chief, Training Division, California State Fire Marshal's Office
Paul Dempsey - California Youth Authority representative to the Statewide Advisory Committee for Public Safety Education - Director of Training, CYA
Marv Engquist - Past-President, CAAJE - Cerritos College
Tom Feierabend - Past-President, State Association of Fire Educators; President, California Fire Technology Directors Association - Mt. San Antonio College
Gretchen Fretter - Past-President, CADA - Los Medanos College
Max Futrell - Four-year college representative to the Statewide Advisory Committee for Public Safety Education - CSU Fresno
Richard Doshen - Representative, California Police Chiefs Association - Yuba City Police Department
Steve Hart - Deputy Director, California State Fire Marshal's Office
Ron Havner - Dean, Public Safety Training, Evergreen Valley College
Mary Jennings - Representative, California Professional Firefighters
Dick McGrath - Public Safety representative to the State Academic Senate - Cerritos College
Bill Ogden - Representative, California State Firefighters Association Education Committee—Rancho Santiago college (ret.)
Chuck Page - Deputy Director, Standards and Training for Corrections, Board of Corrections
Jim Pope - Representative, California State Sheriff's Association - Shasta County Sheriff's Department
Frank Scotti - Southern California representative to the Statewide Advisory Committee for Public Safety Education for the California Fire Technology Directors Association - Rancho Santiago College

APPENDIX B

**STATEWIDE ADVISORY COMMITTEE
FOR PUBLIC SAFETY EDUCATION MEMBERS**

Public Safety Curriculum and Professional Development Project

STATEWIDE ADVISORY COMMITTEE FOR PUBLIC SAFETY EDUCATION

Project Coordinator: Fred Allen, Dean of Instruction, Area I, Butte College
Chancellor's Office Representative: Leo Ruelas, Specialist in Public Safety Education

Business/Industry Representatives

Ron Allen	Chief - Training, Delivery and Compliance	Commission on POST
Arthur Branstine	President	Westec Security, Inc.
Armand Burrue	Asst. Dep. Dir., Human Resources Devel.	California Dept. of Corrections
Paul Dempsey	Chief, Training Services Division	California Youth Authority
Steve Hart	Deputy Director	Office of the State Fire Marshal
Thomas McConnell	Director	Board of Corrections
Jim Pope	Sheriff	Shasta County Sheriff's Dept.
Oliver Thompson	Chief of Police	Inglewood Police Department
Ray Vittori	Fire Chief (ret.)	Emeryville Fire Department

Education Representatives

Ann Boyce	Assoc. Prof., Applied Sci. and Tech. Dept.	Bakersfield College
Representative: Environmental Technology/Hazardous Materials		
Kelly Chun	Dean, Public Safety Center	Sacramento City College
Max Futrell	Professor/Chair, Dept. of Criminology	CSU, Fresno
Representative: Four-year Colleges		
Ronald Havner	Dean, Public Safety Training	Evergreen Valley College
Jan Hayes	Professor, Science Division	Merced College
Stan Kephart	Director, Public Service Center	Butte Community College
Richard McGrath	Professor, Administration of Justice Dept.	Cerritos College
Representative: State Academic Senate		
Frank Patino	Division Dean, Dept. of Public Service	Rio Hondo College
Representative: California Academy Directors Association (CADA)		
Frank Scotti	Director, Fire Technology Department	Rancho Santiago College
Representative: Fire Technology Directors Association (for Southern California)		
James Smith	Professor, Administration of Justice Dept.	West Valley College
Representative: California Association of Administration of Justice Educators (CAAJE)		
John White	Coordinator/Fire Chief	Shasta College
Representative: Fire Technology Directors Association (for Northern California)		

APPENDIX C

**CURRICULUM DEVELOPERS AND
CONTRIBUTING REVIEWERS**

Public Safety Curriculum and Professional Development Project

CURRICULUM DEVELOPERS AND CONTRIBUTING REVIEWERS

(other than Steering Committee or Statewide Advisory Committee members)

Neal Allbee, Sierra College
Bev Bair, California Department of Corrections
Craig Baker, Cosumnes River College
Bruce Beckler, Napa Valley College
Art Cota, State Fire Marshal's Office
Mary Kay Borchard, Imperial Valley College
Ray Bowling, Miramar College
J. Robert Camarillo, Ventura College
Tom Carey, California Department of Corrections
Richard Casagrande, RAM Environmental Engineering
Alberto Caton, California Department of Corrections
Steve Chaney, Commission on Peace Officer Standards and Training
Les Clark, Sacramento City College
Dan Coffman, Rio Hondo College
Mike Collins, Fresno City College
Gary Creason, Southwestern College
Beverly Curl, Long Beach City College
Carol Daly, Sacramento County Sheriff's Department
Dan DeLeon, Sacramento Police Department
Richard Della Valle, Napa Valley College
Dan Dale, Porterville College
Jim Embree, Sacramento City College (retired)
Tom Feierabend, Mt. San Antonio College
Bob Fuller, Commission on Peace Officer Standards and Training
Art Garrett, Alameda County District Attorney's Office
Mary Girty, Allan Hancock College
Dr. Joel Gormick, Rancho Santiago College
Charles Graham, Solano College
Howard Guyer, Fullerton College
Bob Halliburton, Allan Hancock College
Leo Hertoghe, California State University, Sacramento
Don Hulse, Long Beach City College
Katherine Hickman, Fresno City College
Jay Holmes, California Youth Authority
Richard Honey, Commission on Peace Officer Standards and Training
Karl Hutchinson, Sacramento City College
Everett Johnson, Commission on Peace Officer Standards and Training
Kelly Jones, Commission on Peace Officer Standards and Training
Judy Kaci, California State University, Long Beach

Richard Keller, Rancho Santiago College
Terry Koeper, Southwestern College
Bill Lane, Allan Hancock College
Max Lemon, California Department of Corrections
Mike Leovich, California Correctional Peace Officers Association
Michael Malachowski, City College of San Francisco
Robert Martinez, Sacramento City College
Jim McGinley, San Diego Police Department
Ellen Melton, California Department of Corrections
Rick Michelson, Grossmont College
Wanda Milton, California Youth Authority
Charlene Nagy, Miramar College
Jim Newman, Rio Hondo College
Leo Nowak, California Correctional Peace Officers Association
Stephen Onstot, Burke, Williams and Sorenson
Doug Peterson, California Correctional Peace Officers Association
Rick Ramos, Santa Rosa Junior College
Don Ranish, Antelope Valley Community College
Marc Revere, Palomar College
Patricia Robinson, Sacramento City College
Alex Rodriguez, California Department of Corrections
Michael Rosa, California Department of Corrections
Carlos Sanchez, California Department of Corrections
Frank Scotti, Rancho Santiago College
David Senior, Allan Hancock College
Steve Segura, Sacramento Police Department
Ed Smith, Crafton Hills College
Jim Smith, West Valley College
Douglas Taber, California Department of Corrections
Steve Thorpe, Sacramento City College
Keith Twitchell Jr., Solano College
Teri Wann, Rancho Santiago College
John White, Shasta College
Tom Whitt, Fresno City College
Allison Zajac, California Youth Authority
Muriel Zimmerman, Chaffey College
Ken Zion, El Camino Community College

Mary Thorpe, Gender Equity and Special Populations Consultant

CHAPTER 1

INTRODUCTION

A group of community college educators met in the Fall of 1988 and drafted a proposal that has resulted in a new vocational program. The **goal** of this program is *to prepare students with the knowledge and skills that would allow them to work with hazardous substances in compliance with governmental regulations, and at the same time protect human health and the environment*. It is known as the **Environmental Technology (ET)** Certificate and Associate Degree program.

Faculty participated in UC Davis Extension's Hazardous Materials Management training in the Summer of 1989 and, upon returning home, continued their pursuit by participating in 120 hours of on-the-job training activities. The Environmental Hazardous Materials Technology Consortium conducted a state-wide survey of industry needs, formed local advisory committees, attended monthly consortium meetings, and remained in weekly contact by telephone conferencing. From this flurry of activities, and with the aid of seven industry advisors, a list of 95 program competencies (located in Appendix E) were developed. These skills were then carefully subdivided, creating six new courses.

To provide for uniform content coverage at each of the colleges, faculty writing teams developed detailed course outlines and weekly lesson plans for each of the courses. By Spring 1990, these outlines and lesson plans, along with both the certificate and associate degree requirements, were submitted to the State Chancellor's Office for final approval.

By Fall 1990, each of the "original" eight colleges had received local curriculum committee approval, and were offering, at least, the first of the new six courses. Also, the consortium expanded by the selection of six additional colleges. Consortium colleges, by agreement, will offer the same certificate and associate degree programs. Therefore, students finding it necessary to transfer from college to college will receive full transfer credit within the program. The number of California Community Colleges that have been approved to offer the ET program is twenty-nine.

California has a \$3 billion resource unmatched by any other state: 107 community colleges providing lifelong learning opportunities within driving distance of virtually every state resident. Colleges across the state offer an impressive array of courses designed to provide California workers with the kinds of knowledge and skills needed by California business and industry.

ED>Net, the **California Community College Economic Development Network**, was created in 1989 to work with business and industry to identify the state's economic development priorities and provide the means to facilitate that development. As formally stated, ED>Net's mission is to advance California's economic growth and global competitiveness through quality education and services focusing on continuous workforce improvement, technology deployment, and business development.

In a 1990 *Department of Commerce Survey of California Manufacturers* it was reported that manufacturers placed waste disposal as their most burdensome environmental issue. It also reported that most businesses learned about new or changing environmental rules and regulations from other business groups. Although worker compensation claims have now likely replaced it, the survey further found that manufacturers ranked streamlining environmental regulations first in a list for potential state policy changes.

Environmental Technology

Large businesses have generally fared better in this arena than the smaller ones. They typically have the attorneys, engineers, and chemists to help keep them in compliance in the ever changing myriad of federal, state and local laws. But in a 1990 community college survey of over 12,000 large and small California businesses, it was found that both groups need hazmat technicians to perform the “hands on” tasks that are a vital part of the day-to-day environmental compliance activities of the company.

Based on these findings, one of the early projects funded by ED>Net was to design a program to supply businesses with individuals trained to work with hazardous substances in compliance with the regulations, and at the same time protect human health and the environment. The result of this effort is the Environmental Technology (ET) Certificate and Associate Degree program.

Although some courses in the ET program have similar titles, most offerings differ strikingly from the current UC Extension’s offerings. Closer examination reveals that while UC focuses on the concerns of management, the ET program stresses training for the hands-on worker. The ET program is the first credit Certificate/Associate Degree program offered by any segment of California higher education.

Students entering the ET program represent a wide range of backgrounds. Most are already employed and may possess advanced degrees. Others are receiving support from their employers to meet “add-on” responsibilities that they have been or will be assigned. Some of the students are putting their skills into practice, even before they complete the certificate requirements, and have been rewarded at their jobs with both title and pay promotions.

From the eight “founding” colleges approved to offer the program in 1990, and with the financial support of the Partnership for Environmental Technology Education (PETE), 29 colleges eventually joined the ET Consortium.

At present, there are three articulated Bachelor’s Degree programs spawned by the community college’s efforts. Cal Poly, Pomona and California State University, Long Beach have developed Environmental Engineering Technology degrees, and California State University, Bakersfield has remodeled a former program into an Environmental Resources Management degree. All of these programs will use the six “core” ET courses as their lower division requirements. As is typical in other degree programs, all other required lower division courses may also be taken at a local community college.

Within the last 5 years, the ET program has received a tremendous boost from PETE, an organization comprised of representatives from government, industry, and education committed to furthering Environmental Technology education. PETE is funded by grants from the U.S. Department of Energy, the Environmental Protection Agency, the National Science Foundation, and other organizations. By leveraging PETE’s federally derived resources, there has been a significant growth in California’s program, and it has expanded into several other Western states. PETE also arranged for instructors in the PETE area to participate in a number of in-service training opportunities. Some of the facilities participating in this training include Lawrence Livermore National Laboratory, Lawrence Berkeley Laboratory, Sandia National Laboratories, EPA’s Environmental Monitoring Systems Laboratory, DOE’s Nevada Test Site, and NASA’s Jet Propulsion Laboratory.

To initially define the ET program’s curriculum, seven industry advisors and eight community college instructors identified 95 competencies (skills) in which program participants would need training. They sent questionnaires to more than 12,000 businesses to determine current practices and future needs. Six new courses, totalling 21 units of focused course work, were designed and nearly 3,000 pages of instructional materials assembled to meet the program’s carefully defined competencies.

Environmental Technology

Upon successful completion of these six “core” courses and the required prerequisites in chemistry, environmental science, biology and communication skills, program participants receive an ET Certificate. Students desiring to earn the Associate Degree in Environmental Technology may do so by completing the college’s additional general education requirements.

Students are advised to start the six “core” course sequence with **Introduction to ET**, which provides an overview of the hazardous materials technology area, including sources of pollution, the effects of hazardous substances on the ecosystem and human health, finding and understanding regulations, and possible career opportunities. This course was offered for the first time in the Spring/Summer of 1990 at the eight “founding” colleges.

This course is followed by **Health Effects of Environmental Hazardous Materials** which covers the basics of toxicology and industrial hygiene. The effects of acute and chronic exposure to chemical, physical and biological agents, emphasizing hazardous materials associated with industrial operations, waste disposal, and remediation sites are presented, followed by instruction on how to make the work place safer through the use of personal protection, monitoring, and engineering procedures.

Utilizing the “Material Balance” concept, students in the **Waste Generation/Reduction/Treatment** class study the generation of waste streams in several typical California industries, including an understanding of raw materials and chemicals used, examining changes occurring in the industrial processes and the importance of waste minimization/treatment procedures. Even the home as a hazardous waste generator is considered.

Each of the above 3 unit classes require students to attend 54 hours of classroom instruction and examinations. The three remaining classes are each 4 unit courses requiring an additional 54 hours of “hands-on” activities. The first two of these classes cover the regulations that govern how hazardous materials and wastes must be stored, labeled, handled, and shipped.

Hazardous Materials Management Applications teaches the requirements and application of federal, state, and local laws and regulations relating to hazardous materials, including planning and reporting procedures, and is reinforced with hands-on applications of these laws in the hands-on portion of the course.

Hazardous Waste Management Applications is a similar overview of hazardous waste laws and regulations with an emphasis on generator compliance, site investigation and remediation, permitting, enforcement, and liability considerations. Within this course there are also 45 hours of lecture and hands-on and laboratory time devoted to sampling and analysis procedures. The topics range from how to develop a sampling plan to actually using field instruments and laboratory instruments such as a pH meter, spectrophotometer, and gas chromatograph.

The final course in the sequence is the **Safety & Emergency Response** class. In this class students are provided with hands-on instruction in safety and emergency response to chemical and physical exposures in industrial and field settings. Topics include hazard analysis, selection of the proper protective equipment (PPE), contingency planning, site control and evaluation, field sampling and monitoring, and the proper use of field testing instruments. (The 40 Hour OSHA Certificate is now earned by most students.)

The ET Program was selected to receive a certificate of environmental achievement from **Renew America**, a Washington, D.C. based national environmental organization. Renew America is a nonprofit organization committed to restoring the nation’s communities through environmental action. Programs selected for recognition are listed in the **1992 Environmental Success Index**, a comprehensive guide to the nation’s successful environmental programs.

Environmental Technology

The updated Hazardous Waste Management Applications and Waste Generation, Reduction, and Treatment courses were developed by this project, while the other four courses were developed by the California Consortium of Community Colleges' ED>Net Task Force on Applied Competitive Technologies. All of the courses are presented here in an effort to create easier access to the curriculum materials essential to educators in the field of Environmental Technology.

CHAPTER 2 - Required Courses

Introduction to Environmental Hazardous Material Technology

Instructor's Guide

Prepared By:
Craig Baker
Cosumnes River College
B401 Center Parkway
Sacramento, CA 95823-5799

Prepared For:
California Community College
Environmental Hazardous Materials Consortium
September, 1990

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Availability

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Richard Casagrande, President, RAM Environmental Engineering Services, Bakersfield, CA

Donna Gilmore Rhee, Director, Program Administration, EnsecoCal Laboratory, Sacramento, CA

George Graff, Industrial Engineer/Consultant, Costa Mesa, CA

Robert Weimer, Weimer Manufacturing Co., Inc., Atwater, CA

James A. Charley, RayChem Corporation, Menlo Park, CA

Meier Schneider, Professional Engineer, C.I.H., Los Angeles, CA

Special thanks to Nona Griffin for her word-processing on this project.

Designed by Jim More, West Hollywood, CA.

Preface

This is the instructor's guide for one core course in the California Community College Environmental Hazardous Materials Technology (EHMT) Associate Degree and Certificate Curriculum. This curriculum was developed by the California Consortium of Community Colleges' ED>Net Task Force on Applied Competitive Technologies and funded by the eight participating community colleges and the State Chancellor's Office.

The overall goal of the EHMT curriculum is to provide community college students with the knowledge, skills, and understanding that will enable them to work with hazardous materials in a manner that protects human health and the environment and is fully in compliance with governmental regulations.

Each of the six core courses within the curriculum is designed to provide the student with competencies that have been identified by industry advisors and hazardous materials professionals as necessary for the successful Hazardous Materials Technician to possess. Lesson Plans in this guide fulfill necessary competencies and give instructors suggestions as to the order and manner to impart them to students.

The EHMT Curriculum emphasizes development of the following major competencies:

The ability to understand and comply with applicable regulations

Proper handling and sampling of hazardous materials

Development and implementation of plans and procedures for compliance

Responding safely and effectively to emergency incidents

Maintaining professional competence

Environmental Technology

EHMT Core Courses

Introduction to Environmental Hazardous Materials Technology	3 units
Health Effects of Hazardous Materials	3 units
Hazardous Waste Management Applications	4 units
Hazardous Materials Management Applications	4 units
Waste Generation, Reduction, and Treatment	3 units
Safety and Emergency Response	4 units

INTRODUCTION TO HAZARDOUS MATERIALS TECHNOLOGY

This is a core course that surveys the topics that are covered in greater depth in other courses in the curriculum. It is a three unit course designed to give the student a general overview of the environmental hazardous materials (EHMT) field. A historic perspective of the legislative processes that lead to current regulations, where to find these regulations, and how to read them will be presented. The course introduces legal definitions, terminology, and the regulatory framework of EHMT. A discussion of career opportunities is included. The competencies fulfilled by this course are:

I. Understanding and Complying with Regulations

A. Understands the Rulemaking Process

1. Coding and basic numbering
2. Organization
3. Bureaucratic hierarchy (Federal, State, or Local origins)
4. Historical perspective

B. Determines Regulatory impact

1. Identifies statutes and regulations
 - a. air, water, soil, employee, and public health/safety
 - b. keeps current on requirements
2. Determines scope and application
 - a. reads and comprehends laws and regulations
 - b. understands liabilities and penalties
 - c. is sensitive to political sensitivities

C. Identifies Regulatory Sources and References

1. Determines regulatory jurisdiction (Federal, State, or Local Agencies)
2. Makes proper contacts
 - a. agencies with regulatory authority
 - b. information support services (e.g. Chemtrec, Chlorine Institute)
3. Distinguishes between regulations and organizational policies

II. Maintenance of Professional Competence

- A. Reads and Understands Current Publications
- B. Attends Classes, Seminars, Workshops
- C. Participates in Professional Associations
- D. Acquires and Maintains Certification
- E. Participates in Community Relations Activities

Table of Contents

- Lesson 1—Historic Perspective
- Lesson 2—Chemistry of Hazardous Materials
- Lesson 3—Basic Toxicology
- Lesson 4—Occupational Safety and Health
- Lesson 5—Governmental Processes
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- Lesson 7—Air Pollution
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- Lesson 9—Hazardous Materials/Waste Laws
- Lesson 10—Industrial Hazardous Materials
- Lesson 11—Career Opportunities

1. Historic Perspective

Intent and Approach

Introduction to Environmental Hazardous Materials Technology (EHMT) is a course which serves the topics and concepts found within the EHMT curriculum. Lesson 1 provides a historic overview of the development of environmental protection and workplace safety laws. A chronology of past events, situations, and political movements is used to give students a perspective of how public perceptions and opinions can give rise to legislation and enforcement authority. Examples of the kinds of operations and tasks that are fundamental to hazardous materials handling, resource recovery, waste treatment and management systems, etc. are used to delineate the extent of the EHMT industry. The kinds of jobs potentially available to EHMT students and the training needed to acquire them is discussed.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Trace** the origins of the public health, environmental protection, workplace safety and resource conservation movements.
2. **Recount** the historical events which led to the enacting legislation for: CWA, OSHA, DOT, EPA, etc.
3. **Categorize** the type of agencies and businesses that are involved with workplace safety/health and environmental cleanup/monitoring, etc.
4. **Discuss** the kinds of prerequisite skills a student must have to become employable in the EHMT industry.

Lesson Outline

1. Thoroughly discuss the College's EHMT Program, its objectives and requirements:
 - Program's curricular materials, degree requirements, etc.
2. Explain the expectations and goals of the Introduction to EHMT course:
 - 1234• Course syllabus, calendar, office hours, etc.
 - Expected assignments, activities, papers, etc.
 - Grading scheme, attendance expectations, etc.
3. Provide examples and discussion of:
 - Historic events and legislation concerning air/water/soil pollution, workplace safety and health, public sanitation, resource conservation, etc.
4. Show a "kickoff" film/video that deals with: An eco-disaster, air/water/soil pollution, the disposal of toxic wastes, etc.
 - Indicate what agency(s) might have jurisdiction
 - What laws might have been violated
 - What tasks would have to be performed to "clean-up" the pollution?
5. Roughly outline the extent of the EHMT industry:
 - Management and Service firms• Consultant and Engineering organizations
 - Hazardous Materials storage/transportation requirements
 - Hazardous Waste treatment, storage, and disposal operations
 - Government agencies, etc.
6. Discuss the job skills utilized within the EHMT industry and the training they require; describe some entry level jobs.
7. Review the concepts and definitions introduced in the unit.

Suggestions for Development and Presentation

One should not go into too much detail in the introductory unit! Remember, all of the topics presented in Introduction to EHMT are covered in depth in subsequent courses. The effort in Lesson 1 is to provide an overview of the EHMT program, its content, and the possibilities it holds for a given student's future.

Overhead transparencies can be used to present a chronology of historic events and political movements, regulatory agency responsibilities and jurisdiction, legislative intent/goals for various laws, etc.

Films and videos can be used to capture student interest and focus class discussions. Many are available that depict events like: Times Beach, Bhopal India, major oil spills, groundwater pollution sites in Silicon Valley, dramatic hazardous materials fires/explosions, etc.

Environmental Technology

Case studies can be developed, by instructor or by students, around topics such as: 1) The need for uncontaminated food/water 2) working conditions in mines and mills, and 3) resource recovery/conservation.

References and Resources

A section titled “Historical Perspective” can be found in:

Dangerous Properties of Industrial Materials by N. Irving Sax

The *Iowa HMT 100* and *HMT 210 texts* contain introductory histories concerning hazardous material incidents and the need for workplace safety laws.

The Complete Guide to Environmental Careers, The CEIP Fund, DeAngelis, L. P. Project Director, Island Press, 1989

Principals of Hazardous Materials Management by Roger D. Griffin, Lewis Press, 1989 (suggested course text)

Inexpensive Newsletters, Reports

Public Agency Safety News (free) State Compensation Insurance Fund, Safety & Health Services Dept., 1275 Market St., San Francisco, CA 94103 (415) 565-1366

Silicon Valley Toxics News (\$20) Silicon Valley Toxics News, 760 N. First St. 2nd Floor, San Jose, CA 95112, (408) 287-4707

Various Reports from: Office of Joint Publications, State Capitol, P.O. Box 942849, Sacramento CA 94249

Videos

Oil! Spoil!: Patterns in Pollution. Sierra Club Film Distribution Center, 13500 N.E. 124th St., Suite 2, Kirkland, WA 98034, (206) 820-2592

Toxic Chemicals: Information is the Best Defense. California League of Woman Voters or Bullfrog Films, Oley, PA 19547

Restoring the Environment. Films for the Humanities/Sciences, P.O. Box 2053, Princeton, NJ 08543, (800) 257-5126

Toxic Turmoil: The Silicon Valley Story. Modern Talking Pictures or Clean Water Task Force

Schedule and Assignments

Lesson 1 can take 2 to 3 hours depending on whether or not:

- films/videos are used and to what extent the topics they introduce are dealt with.
- a lengthy discussion follows the overview presentation of the college’s EHMT program and the kinds of career opportunities it provides.
- the class fills out a survey which characterizes their interest in the EHMT curriculum and elicits demographic information.

Suggested Test Questions and Answers

Questions:

1. Name an historic event that gave rise to a particular piece of environmental protection/workplace safety legislation and name the legislation.
2. List the kinds of organizations and/or businesses that are potential employers of EHMT graduates.
3. Briefly describe the goal(s) the Congress had, when it wrote enabling legislation such as EPA, CWA, RCRA, etc.

Answers:

1. Love Canal: CERCLA
2. Governmental Agencies: federal, state, local industrial concerns that generate, treat or store hazardous wastes, service firms which are involved in “clean-up”, disposal, site characterization, etc.
3. Protect the environment and human health; conserve energy and natural resources; reduce the amount of waste generated; regulate and control the disposal of hazardous waste.

Supplemental Instructor and or Student Materials

**FEDERAL INSECTICIDE, FUNGICIDE and
RODENTICIDE ACT**

**HAZARDOUS MATERIALS TRANSPORTATION
ACT**

RESOURCE CONSERVATION & RECOVERY ACT

**COMPREHENSIVE ENVIRONMENTAL RESPONSE,
COMPENSATION and LIABILITY ACT**

TOXIC SUBSTANCES CONTROL ACT

CLEAN AIR ACT

CLEAN WATER ACT

**SUPERFUND AMENDMENTS and
REAUTHORIZATION**

SAFE DRINKING WATER ACT

FEDERAL WATER POLLUTION CONTROL ACT

HAZARDOUS SOLID WASTE AMENDMENT ACT

NATIONAL ENVIRONMENTAL POLICY ACT

EPA GOALS

To PROTECT HUMAN HEALTH and
The ENVIRONMENT from IMPRUDENT
DISPOSAL of HAZARDOUS WASTES

To CONSERVE ENERGY and
NATURAL RESOURCES

To REDUCE the AMOUNT
of WASTE GENERATED

To REGULATE and CONTROL
The GENERATION and DISPOSAL
Of HAZARDOUS WASTES, in an
ENVIRONMENTALLY SOUND MANNER

WATER QUALITY

AESTHETICS

COLOR
ODOR
TASTE
SCUM
TURBIDITY

DRINKING WATER CRITERIA

PHYSICAL
MICROBIOLOGICAL
ORGANIC CHEMICALS
INORGANIC CHEMICALS
RADIOACTIVITY

AQUATIC ENVIRONMENT

DISSOLVED OXYGEN

AGRICULTURAL NEEDS

SOURCES/ SALINITY
IRRIGATION
STOCK SUPPLIES

INDUSTRIAL NEEDS

COOLING
STEAM GENERATION
CLEANING/ RINSING
DIGESTER/ SOAKERS

2. Chemistry of Hazardous Materials

Intent and Approach

The fundamental chemical concepts that underlie the behavior of hazardous materials are presented. Basic information concerning chemical and physical phenomena, necessary for further study in the EHMT curriculum, is described and discussed. Major chemical terms are defined.

Examples of usage (e.g. MSDS) and definitions employed by agencies (e.g. DOT) are utilized in an effort to make the application of chemical fundamentals real and usable. To successfully complete this lesson, the student will be able to complete the following:

Lesson Objectives

1. Define major chemical terms (a vocabulary list is provided in Lesson Outline).
2. **Differentiate** between paired meanings:
 - Physical and Chemical Properties
 - Elements and Compounds
 - Metals and Nonmetals
 - Covalent and Ionic Bonds
 - Polar and Nonpolar Molecules
 - Acids and Bases
 - Organic and Inorganic Compounds
 - Solvent and Solute
3. **Categorize** nature of:
 - Covalent Bonding
 - Acids-1 Bases
 - Organic Compounds: Structural Formulas
 - Oxidizers
4. *Interpret* various compound naming/designation schemes and the use of chemical lists.
5. *Manipulate and order* typical concentration units.
6. Describe how the chemical nature of compounds can be used to explain their differences in:
 - Reactivity
 - Toxicity
 - Volatility
 - Distribution and fate in the environment
 - Solubility
 - Hazard class

Lesson Outline

1. Inform students of the nature and objectives of Lesson 2 and survey their prerequisite knowledge before beginning instruction.
2. Present the subdivisions of matter:
 - Elements, Compounds, Mixtures
 - Pure, Impure, Heterogeneous, Homogeneous, etc.

Environmental Technology

- Physical and Chemical Properties
 - Hazardous Substances/Materials/Wastes
3. Explain the nature of gases, liquids and solids in terms of the kinetic-molecular theory of matter. Emphasize the relationship between intermolecular forces and volatility.
 4. Introduce a simplified version of atomic structure.
 5. Denote the organization of the Periodic Table and its subdivision into metals and nonmetals.
 6. Discuss a rudimentary scheme for Chemical Bonding:
 - Electrical in Nature
 - Metal - Nonmetal = Ionic; Nonmetal - Nonmetal = Covalent
 - Structures and Geometries: polar groups/molecules
 - Applicable water vs. hexane solubilities
 7. Expound on the complexity of compound formation; specifically the large number of possible combinations, structures, etc.:
 - Rn vs. O₂
 - O₂ vs. O₃
 - CH₄ vs. CCl₄
 - CO vs. CO₂
 - i-Propyl vs. n-Propyl Alcohol
 - Use MSDS examples; denote CAS#, DOT# references
 8. Discuss various types of organic compounds and why they are soluble/insoluble in H₂O/hexane:
 - Simple hydrocarbons: straight/branched chains, rings
 - Aromatic: benzene-based family of compounds
 - Substituted functional groups: chlorinated hydrocarbons
 - Oxidation to alcohols, aldehydes, carboxylic acids, CO₂
 9. Examine the processes involved in solution formation:
 - Solute - Solvent interactions

- Like dissolves like: H₂O/hexane differences
- Measures of concentration
- Differences in evaporation rates: vapor pressures

10. Go over any vocabulary words that have not yet been covered:

%, ppm, ppb, mg/kg, ml/l, Metric Measures
Acids, Bases, Caustic, Corrosive, pH
Aliphatic Compounds, Aromatic Compounds, Benzene
Atom, Atomic Number, Electron, Proton, Neutron, Nucleus
Boiling/ Boiling Point, Evaporation, Heat of Vaporization
CAS Number, Common Names, DOT Hazard Class, MSDS
Catalyst
Chemical Properties, Chemical Reaction, Physical Properties
Combustibility, Flammability, Flash Point
Compounds, Elements, Mixtures
Covalent Bond, Ionic Bond, Ion, Ionization
Decomposition
Diffusion
Electrolytes
Energy Levels
Functional Groups
Gases, Liquids, Solids, States of Matter
Halogens
Heavy Metals, Metals, Nonmetals
Hydrocarbons, Unsaturated Hydrocarbons
Hydrolysis
Hydrophilic
Inert
Inorganic, Organic
Intermolecular Forces, Volatility
Isomer
Isotope
Kinetic Molecular Motion
Melting/Melting Point
Molecular Weight, Molecular Formula, Molecule
NIOSH Number
Nonpolar Molecule, Polar Molecule
Oxidation, Oxidizers
Periodic Table
Reactivity/Stability
Scientific Notation
Solubility, Solute, Solutions, Solvent
Specific Gravity
Vapor Pressure
Density
Structural Formula
Subatomic Particles
Synonyms

Environmental Technology

11. Review the concepts and definitions introduced in the lesson.

Suggestions for Development and Presentation

Lesson 2 attempts to give the beginning student a rudimentary vocabulary concerning chemical concepts. Later studies of toxicology, workplace safety, media transfer, etc. will rely on the materials presented in this unit. Every effort should be made to make this section of the course applicable and “real world.” To make the presentation as concrete as possible, use examples from topics that will come later in the course (e.g. reading a MSDS). Most EHMT students will have had a chemistry class, so we do not need to teach this lesson in extreme detail.

Visuals (slides and overhead transparencies) can be created to facilitate student understanding of atomic systems, molecular structures, pH scales, families of organic compounds, etc.

References and Resources

Documents

- A sample MSDS
- DOT Hazard Classification Scheme
- DOHS List of Lists

Books

Chemistry for Fire fighters

Films

Physics and Chemistry of Water

Schedules and Assignments

Lesson 2 can take 3 to 5 hours depending on whether or not:

- students are able to quickly assimilate and apply the concepts.
- a large block of time is committed to the discussion of organic compounds, chemical hazards, heavy metals, etc.
- the reading/interpreting of product labels, the definition of chemical terms found on MSDSs, the perusal of lists of hazardous materials from OSHA, DOT, etc. are incorporated into class exercises.

Suggested Test Questions and Answers

Questions:

1. Differentiate between a compound (e.g. sugar) and a mixture (e.g. concrete).
2. Distinguish between a solvent and a solute.
3. Describe the process of evaporation in your own words.

Answers:

1. A compound is a chem-combination of different elements in a fixed ratio. A mixture is an intermingling of various components, that retain their identities, in proportions which can be varied.
2. The substance that does the dissolving and is present in the larger portion is the solvent; that which is dissolved is the solute.
3. Energetic surface molecules at the surface of a liquid are able to free themselves from the constraining forces and escape the surface into the gaseous state.

3 Basic Toxicology

Intent and Approach

This unit is designed to give the beginning EHMT student a insight into the health risk associated with toxic chemicals. An elemental chemical, biological and toxicological background is established to enable the student to understand discussions of risk assessment, hazardous materials management strategies, etc. “Real world” examples taken from OSHA requirements, Industrial Hygiene guidelines, and toxicity studies are used to make concepts and discussions meaningful and concrete. To successfully complete this lesson the student will be able to:

Lesson Objectives

1. Define principal health effects terms (see vocabulary list in Lesson Outline).
2. *Differentiate* between paired meanings:
 - Acute and Chronic exposures
 - Dose and Exposure
 - TLV’s and PEL’s
 - Toxicity and Reactivity
 - Digestive and Respiratory systems
 - Biomedical and Environmental monitoring
 - Fumes and Vapors
 - ppm and mg/kg
 - Fat soluble and Water soluble compounds
 - Excretion and Absorption
 - Biotransformation and Bioaccumulation
 - Risk and Hazard
 - Animal and Epidemiological studies
3. Characterize the nature of:
 - LDy determinations
 - Extrapolation of data
 - Biotransformations
 - Systemic poisons
 - Low Dose Modeling and Extrapolation
4. *Rank* exposure values as to their relative degree of toxicity.
5. DISCUSS, in general terms, when, where, and why the wearing of a respirator might be required.
6. Us the major components of the Risk Assessment Process.

Lesson Outline

1. Inform your students as to the content of and the instructional goals for Lesson 3 and survey their prerequisite knowledge before beginning the unit.
2. Expound on the chemical and physical nature of toxic substances:
 - The nature of poisons
 - The properties of a toxic substance that would explain the way it is distributed and retained within the body;
 - The health effects associated with toxic substances: carcinogens; mutagens; teratogens; asphyxiants; irritants; sensitizers; classes of toxic substances dusts, fumes, mists, vapors, etc.
3. Utilize a simplified Lock and Key model to explain poisoning.
4. Describe the relationship of exposure to ascribed health effects:
 - The vocabulary of exposure limits/duration's/guidelines
 - PEL's, TLV's, TWA's, STEL's, etc.
 - Acute vs. Chronic exposures, Latency periods
 - The potential need for bio/medical monitoring
 - Define Dose
5. Define and give examples of exposure/dose/potency measures: ppm, ppb, mg/m³, Eg/m³, etc.
6. Demonstrate the relationships exhibited by a Dose/Response curve:
 - Generalized: through origin?, LD50, proportional (straight-line area), etc.
7. List and discuss the routes by which toxicants can be absorbed:
 - Transport media: solids, liquids, gases, vapors, fumes, fibers, mists, etc.
 - Ingestion, inhalation, dermal, ingestion
8. Point out the reaction/response variability that is introduced because of individual differences:
 - Susceptibility, sensitivity, allergic reactions, etc.
 - Acute - chronic effects
 - Detoxification, bioaccumulation, etc.
 - Synergism
9. Use an excerpt from the NIOSH Pocket Guide to compare the chemical nature of two compounds to their: exposure limits, chemical/physical properties, respirator requirements and health hazard.
10. Outline the steps involved in Risk Assessments:
 - Hazard Identification
 - Dose/Response Assessment
 - Exposure Assessment
 - Risk Characterization
11. List some typical prevention and control measures that can be used to protect workers and community.
12. Go over any vocabulary words that have not yet been covered:
 - Acute,
 - Chronic
 - Adsorption
 - Antagonism, Synergism

Asphyxiant
Bioaccumulative
Carcinogens, Teratogens, Mutagens, Latency, Genetic
Damage
Central Nervous System, Circulatory System
Control Group
Detoxification, Distribution, Elimination
Dose, DoseResponse Relationship
Dust, Fumes, Smoke, Vapor
Enzyme Action
Epidemiological Exposure, Exposure Limits
Extrapolation, Linear Extrapolation, Low Dose
Gastrointestinal
Half-Life
Hazard
Interspecies Differences
Irritants, Sensitizers, Allergic Reactions
Kidney, Liver, Lungs, Respiratory System
LC₅₀, LD₅₀, TLC
Medical Monitoring
Metabolism, Metabolite
mg/kg
Modeling
Organ Systems
PEL, TWA, STEL
Pesticides, Poisons, Toxicity
Potency
Reproductive Toxins
Risk, Risk Management, Risk Assessment
Routes of Exposure, Dermal Contact, Ingestion, Inhalation
Target Organ
Threshold
Uncertainty
VOC
Worst Case

13. Indicate the types of situations (where and why) a respirator might be required.

14. Review the concepts and vocabulary introduced in the Lesson.

Suggestions for Development and Presentation

Lesson 3 builds on the introductory chemistry lesson, by applying the concepts introduced in it to presentations concerning: molecular shapes, the water vs. fat (lipid) solubility of a given compound, biochemical reactions which detoxify, etc.

Because most EHMT students will take a Human Biology course and the Health Effects of Hazardous Materials course, one can take a “once over lightly” approach to the presentation of this unit.

References and Resources

Documents

An example MSDS

Exposure Limits & NFPA Hazard Ratings

Books

Principles of Hazardous Materials Management

Griffin, Roger D.

Lewis Press 1989

Dangerous Properties of Industrial Materials

N. Irving Sax

Booklets

Understanding Toxic Substances: An Introduction to Chemical Hazards in the WorkPlace

Hazard Evaluation System & Information Service

2151 Berkeley Way

Berkeley, CA 94704

(415) 540-3014

Toxicology: The Science of Poisons

Craigmill, Arthur L., 1982

Cooperative Extension, Division of Agricultural Science

University of California

Schedule and Assignments

Lesson 3 can take 3 to 5 hours depending on:

- The depth and detail of the explanations given concerning: the reactions of biological systems to poisoning; the difficulties involved in assigning and interpreting risk values.
- The development and application of Risk Management Policies.
- Whether any of the topics spark a lengthy class discussion of “real world” applications of the processes or concepts involved.

Suggested Test Questions and Answers

Questions:

1. In what way(s) are “Synergism” and “Antagonism” different?
2. What is the usual meaning of LD50 values?
3. List the Routes of Exposure to toxic chemicals.

Answers:

1. Synergism represents a unexpected amplification (greater than a sum of both toxicity’s) effect of two toxic substances on the body. Antagonism, on the other hand, exhibits a lessening of impact of one toxic material in the presence of the other in the body.
2. The Lethal Dose for 50% of the test animals.
3. Ingestion, Inhalation and Dermal contact/absorption.

4 Occupational Safety and Health

Intent and Approach

Occupational Safety & Health Act (OSHA). This part of the Introductory course emphasizes the need for informed workers that understand the risks involved in being exposed to potentially injurious chemicals.

The historic problems associated with hazardous substances are discussed and the OSHA Hazard Communication Standard is surveyed. The training needs required by the Hazard Communication Standard and those dictated for Hazardous Waste Site workers are outlined.

Lesson Objectives

To successfully complete this lesson the student will be able to:

1. List two major goals of current workplace safety and health protection practices.
2. *Outline* the scope of workplace safety and health protection practices including areas of coverage, populations served, job categories, etc. of federal and Cal-OSHA.
3. *Give examples of* workplace hazards and the practices which can be used to abate the danger they pose.
4. List the basic elements of the Hazard Communication Standard.
5. *Characterize* the kinds of information found on warning labels and on MSDS’s.
6. *Define* the terms that represent the operational vocabulary of workplace safety and health (a vocabulary list is provided in Lesson Outline).

Lesson Outline

1. Outline the goals and expectations for this unit before starting with instruction.
2. Discuss the historic events that underlie the introduction of modern workplace safety and health practices:
 - Early forms of occupational medicine (Industrial Hygiene)

Environmental Technology

- Working conditions/Worker's Compensation
3. Outline the purpose of various agencies involved with workplace health and safety issues:
 - OSHA, NIOSH, MSHA, Centers for Disease Control, etc.
 4. Differentiate between chemical and physical hazards.
 5. Examine the main elements of the Hazard Communication Standard:
 - Develop and maintain a written Hazard Communication program;
 - Generate and maintain a list (inventory) of all hazardous materials used in the facility;
 - Create and maintain a MSDS file for all chemicals used in the workplace;
 - Label containers of chemicals used in the workplace;
 - Provide employee information regarding chemical hazards and training concerning protective measures to be instituted.
 6. Use a training matrix to indicate the training that is required for Hazardous Waste Site workers:
 - Hazard identification;
 - Basic health effects;
 - Industrial hygiene;
 - 'Worker's Right-to-Know';
 - Regulatory aspects;
 - Monitoring equipment;
 - Site safety plan, etc.
 7. Go over any vocabulary words that have not yet been covered:
 - ACGIH, NFPA, NIOSH, OSHA
 - Chemical Inventory, Emergency Plan
 - Confined Space Standards, IDLH Level
 - Consumer Products
 - Contaminants, Hazardous Materials, Incompatible Materials
 - Director's List (Cal-OSHA)
 - Disposal Procedures
 - Employee Training
 - Fire Hazard
 - Hazard Identification, Health Hazard, Physical Hazard
 - Hazard Communication Standard (HCS)
 - Hazardous Waste Site Operations, 29 CFR 1910.120
 - Labels, Warnings
 - Levels of Protection: A, B, C & D, Suit, Clothing
 - Melting Point
 - MSDS: contents/information, Chemical Properties
 - Non-Routine Tasks
 - Physical Data
 - Reactivity

PPE, Respirators

Standard Operating Procedures (SOP)

SCBA

Toxic Substances, Toxic Agents

Warnings

8. Review the concepts and vocabulary introduced in this section of the course.

Suggestions for Development and Presentation

Many films and videos are available which deal with workplace safety and health. Those responsible for OSHA Hazard Communication in your district may have some that fit your needs.

References and Resources

Demo Materials

Set of labels

Respirators and example cartridges

Booklets

The MSDS Pocket Dictionary

Joseph O. Accrocco

Genium Publishing Corp.

1145 Catalyn St.

Schenectady, NY 12303

(518)377-8854

Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities

U.S. Dept. Health and Human Services #85-115, 1985

NIOSH Pocket Guide to Chemical Hazards

U.S. Dept. Health and Human Services #85-114, 1987

Books

Lowry's Handbook of Right-to-Know and Emergency Planning

George G. and Robert C. Lowry, 1989

Lewis Publishing Inc.

121 South Main St.

Chelsea, Michigan 48118

Documents

Example MSDS's

Schedule and Assignments

Lesson 4 can take up to 6 hours to complete depending on how much class time is devoted to “hands-on” exercises such as:

- Creation of an outline for an example Hazard Communication Program;
- Extracting and interpreting information contained on example MSDS's;
- Ordering a MSDS from address on product label;
- Looking up information concerning substances listed on a product label(s);
- Evaluation of an example Evacuation Plan;
- Discussion of why and when respirators are required; etc.

Suggested Test Questions and Answers

Questions:

1. List four basic types of physical hazard.
2. Match the following descriptions (1-7) with the type of health hazard (a-h) listed below.
 1. Burns skin on contact
 2. Causes cancer
 3. Causes skin to itch on contact
 4. Damages genes in sperm or egg cells
 5. Causes liver damage
 6. Damages the fetus during development
 7. Freezes the skin on contact
 - a. Irritant
 - b. Corrosive
 - c. Target Organ Chemical
 - d. Sensitizer
 - e. Carcinogen
 - f. Teratogen
 - g. Mutagen
 - h. Cryogenic
3. Describe the major hazard(s) associated with confined spaces.

Answers:

1. Compressed gases; explosives; fire hazards; reactive chemicals
2. 1.b;2.e;3.a;4.g;5.c;6.f;7.h
3. Poisonous atmosphere; lack of oxygen; lack of easy/quick entry or exit

5 Governmental Processes

Intent and Approach

This lesson provides an understanding of the process by which laws are enacted and the resultant administration of the regulations that are generated by governmental agencies.

The arrangement and interrelationship of the branches of the Federal and California legislatures are explained.

The hierarchial pattern of agency responsibility and jurisdiction is outlined.

Lesson Objectives

To successfully complete this lesson the student will be able to:

1. Describe the steps necessary for the passage of a law in the U.S. Congress and the California Legislature.
2. Recite the sequence of events that begins with a public issue, moves through antecedent law, subsequent regulation development, associated policies, guidelines, and legal interpretations, in order to enact and implement a law.
3. *Characterize* the Federal and State and Local Regulatory Matrix and describe each agency's governmental jurisdiction, and enforcement responsibility.
4. *Define* the terms that represent the vocabulary associated with the legal and political creation of environmental law/regulations (a vocabulary list is provided in Lesson Outline).

Lesson Outline

1. Communicate the objectives you have for the lesson before commencing with instruction.
2. Make use of a simplified schematic to denote the branches of government and their interrelationship.
3. Describe the governmental and administrative processes that give rise to environmental laws and regulations at the State and Federal levels.
4. Describe the responsibility and jurisdiction of the agencies involved with environmental protection and workplace safety and health (California and United States). Create a simplified hierarchical chart to illustrate how the agencies are related and coordinate through their "chain of command".
5. Go over any vocabulary words that have not yet been covered.

Agencies (Regulatory/Enforcement)

Amendments

Assembly, Senate (California/Federal)

Boards

Bounty Hunter Provisions

Cease & Desist Orders

Civil Penalties

Committee Action

Common Law

Environmental Technology

Congress
Criminal Penalties
Culpability
Executive Branch
Final Rule
Injunction
Legislative Branch
Liability
Negligence
Proposed Rule
Public Comment
Regulations
Rulemaking
State Primacy
Statutes
Veto

6. Review the concepts and definitions introduced in the lesson.

Suggestions for Development and Presentation

Read a short excerpt from a legislative bill; and then a portion of a regulation. Contrast the verbs used, the specificity utilized, and the directive nature of the two documents

The use of illustrative schematics and graphic flow charts is one way of creating an understanding of the legislative and rulemaking process.

Jurisdiction maps can be used to identify and lay out the authority area and domains of various State and Local agencies.

References and Resources

Books

California Hazardous Waste Enforcement: A Practical Guide Environmental Law Institute, 1989

The Federal Register: What is it and How to Use it

Office of the Federal Register

Schedule and Assignments

2 to 3 hours of presentation time usually covers the significant concepts and issues related to the legislative process and governmental agency responsibility. However a discussion of association lobbying, local politics, the differences in local basins, regions, jurisdictions, etc., information on initiatives and propositions, sponsoring legislators, etc., can add to the time spent on this lesson.

Appendix A and Appendix B of the Griffin text have a good summary of the governmental matrix!

Suggested Test Questions and Answers

Questions:

1. Give a short explanation of the difference(s) between a law and a regulation.
2. Which of the following is not administered by a California agency?
 - a. Solid Waste Control: Municipal Landfills
 - b. Regulation of Underground Storage Tanks
 - c. Controls the licensing of Pesticides and Herbicides: FIFRA
 - d. Regulation and control of the quality of water taken from surface water supply: Porter-Cologne
 - e. Workplace safety and health issues: General Industrial Safety Orders
3. The primary California State agency involved in regulatory oversight of Air Toxins is:
 - a. AAQ
 - b. CARB
 - c. CHP
 - d. SWRCB
 - e. DHS

Answers:

1. Laws - legislation are proposals that lay out what is to be accomplished in generalized statutory language and authorizes a designated agency to codify rules and directives that will carry out the legislative intent in regulations which can be enforced.
2. C
3. B

6 Eco Distribution of Pollutants

This lesson deals with the processes that disperse potentially harmful substances throughout our environment. This lesson can rely on the student having had previous presentations concerning the nature of environmental pollutants and the health hazard they present. It can be used to “set the stage” for succeeding presentations which deal with water supply contamination, waste site cleanup, and hazardous waste disposal, etc.

Chemical and biological concepts concerning bioaccumulation and biotransformation are discussed and applied to the processes that distribute, concentrate and degrade toxicants in our surroundings.

Local examples of pollution and the resulting cleanup effort should be used to make the discussion real and concrete.

Lesson Objectives

To successfully complete this lesson the student will be able to:

1. List and describe the main environmental compartments.
2. Associate the characteristics of compounds with the way they are ultimately dispersed in the environment.
3. Differentiate between paired meanings:

Environmental Technology

Biotic and Abiotic processes

Persistence and Biodegradation

Dispersion and Accumulation

Photolysis and Hydrolysis

Organic and Inorganic substances

Anaerobic and Aerobic conditions

Primary and Secondary pollution sources

Deposition and Volatilization

4. Characterize the nature of:

- Toxicant concentration within a food chain.
- The fate of heavy metals in the environment.
- Transformation of pollutants by Anaerobic and Aerobic processes.
- A given compound's mobility, amongst the compartments, based on its solubility in various media.

5. Describe the main elements of an Environmental Impact Report.

6. Define the eco-environmental terms introduced in the lesson (a vocabulary list is provided in the Lesson Outline).

Lesson Outline

1. Relate the objectives you have for the unit before you **commence** with instruction.

2. Describe the nature of the Environmental Compartments and how they are interconnected:

- Abiotic and Biotic processes
- Movement of pollutants across compartment boundaries

3. List and discuss types of pollution sources in terms of the media affected:

- Naturally produced and synthetic pollutants.
- Air, groundwater, surface water and soil contamination.
- Disposal of: sewage, solid and hazardous wastes, etc.

4. Examine the main processes that control the fate of pollutants in the environment:

- Physical and chemical properties that govern the distribution, concentration and degradation of pollutants.
- Food chain concentration of toxicants.
- Abiotic and biotic transformations of pollutants.

5. Acquaint the class with the steps followed in generating an Environmental Impact Report (CEQA-EIR and NEPA-EIS).

6. Go over any vocabulary words that have not yet been covered.

Aerobic Conditions

Air/water Pollution

Biochemical Cycles

Bioconcentration

Biomagnification
Biosphere
Biota
Biotransformation
Carbon/Oxygen Cycle
CEQA/EIR
Consumers
Decomposers
Degradation
Detoxification
Distribution
Environmental Impact Statement(EIS)
Environmental Compartments
Food Chain
Hydrologic Cycle
Hydrolysis
Leaching
National Environmental Policy Act(NEPA)
Nitrogen Cycle
Nonrenewable Resources
Oxidation Reduction
Oxides of Nitrogen
Oxides of Sulfur
Photolysis
Producers
Solubility
Toxicants
Transfer/ Transport
Trophic Levels
Volatilization
Water Table

7. Review the concepts and vocabulary introduced in the lesson:

Suggestions for Development and Presentation

Lesson 6 is an attempt to give students an elementary background in ecological principles, specifically those that apply to the fate of pollutants in the environment. The EHMT curriculum assumes that the students will take an Environmental Science course which will deal with these concepts and while it is not necessary to go into excessive detail in teaching this lesson, some preparation must be provided for those students that have no prerequisite background.

Environmental Technology

An effort should be made to develop case studies concerning a nearby contaminated industrial site, the nature of the contamination, the extent of the pollution, what health and environmental effects are expected and the effort that has been made to cleanup the site.

Obtain and hand out a portion of the EIR for a local project.

This is a lesson that can make *good* use of visuals: films, videos, overheads, etc., to depict the relationships and the processes being discussed.

References and Resources

Books

Environmental Science: A Global Concern Resources

Cunningham, W. P. & Woodworth Saigo, B.

Wm. C. Brown, 1990

The Human Impact: Man's Role In Environmental Change

Goudie, A.

MIT Press, 1982

Fate of Pesticides in the Environment

Bigger, James W. & Seiber, J. N.

University of California

Division of Agriculture & Natural Resources

Oakland, CA 9406

Chemistry and Ecotoxicology of Pollution

Connell, Des W. & Miller, G. T.

Wiley Interscience 1984

Articles

Environmental Pollution: A Multimedia Approach to Modeling

Human Exposure

Series of Three (3) Beginning Vol 23 #10 Oct 1989 of

“Environmental Science and Technology”

Schedules and Assignments

Lesson 6 can take 3 to 4 hours dependent on the amount of time one wishes to devote to the concepts and applications it contains. The unit is preparatory to the study of water and air pollution which follow, but Introduction to EHMT is not a science class and the depth and detail of the explanations can be limited if you are pressed for time.

Questions:

1. Water moves through the environment by many means. Give a short description of a water cycle that could occur in days and one that might take years.

2. List 3 processes by which potentially harmful compounds can be broken down (degraded into less toxic materials).
3. Producers are organisms:
 - a. That make movies.
 - b. Obtain energy/nutrients by feeding on other forms of living materials (Heterotrophs).
 - c. That can synthesize food molecules from nonliving inorganic substances (Autotrophs).
 - d. That parasitically take food from a host organism.
 - e. That bind oxygen to nitrogen in the root nodules of legumes.

Answers:

1. Days: evaporation, condensation and runoff from a watershed located near a large body of water and dependent on prevailing winds. Years: the recharge of an aquifer after water is withdrawn from it and used for irrigation.
2. Photolysis, Hydrolysis, Oxidation, Reduction, etc.
3. c

7 Air Pollution

Intent and Approach

This lesson's purpose is to examine the health consequences, control technologies and the regulatory framework associated with air pollution. Included in this examination is a discussion of the long term ramifications of smog, air toxins, acid fogs, etc. in terms of their effects locally and as global issues. This presentation can rely on concepts introduced in previous sections (introductory toxicology and media transfer) to support student understanding of concerns having to do with air pollution. All aspects (e.g. loss of environmental quality, health effects, crop damage, etc.) of exposure to airborne pollutants can be explored in this lesson. National (e.g. the battle over a new Clean Air Act) and local (e.g. Local Air Quality Management District policies) issues can become the basis for student reports and class discussions.

Lesson Objectives

To successfully complete this lesson the student will be able to:

1. Enumerate the kinds of environmental and health damage caused by air pollution.
2. **Describe** the provisions of the Federal and State Clean Air Acts.
3. List sources of air pollution and suggest attenuating control measures.
4. **Characterize** the California regulatory and enforcement scheme.
5. Define the pertinent terms introduced in the lesson (a vocabulary list is provided in the Lesson Outline).

Lesson Outline

1. Discuss the objectives of the unit before beginning instruction.
2. List the major sources of air pollution:
 - * Kinds of releases.
 - * Adverse effects.
3. Describe example air emission control technologies.
4. Summarize the main provisions of the Federal and California “Clean Air Acts”:
 - * Criteria Pollutants
 - * Toxic Air Contaminants
5. Review Other significant air pollution laws/regulations: * AB2588/1807..etc.
6. Outline the local, California and Federal regulatory framework.
7. Examine the “Indoor Pollution” problem.
8. List some air pollution management/ strategy issues: -
 - * “Clean” fuels, automobiles, etc.
 - * Energy conservation, stationary source controls, etc.
9. Go over any vocabulary words that have not yet been covered.
 - Acid Rain, Acidic Deposition
 - Aerosols
 - Asbestos
 - Carbon Monoxide, Carbon Dioxide
 - Chlorofluorocarbons(CFCs)
 - Clean Air Act(CMA)
 - Concentrations
 - Global Warming, Greenhouse Gases
 - Mobile Sources, Stationary Sources
 - National Emission Standards for Hazardous Air Pollutants (NESHAP)
 - National Ambient Air Quality Standards (NAAQS)
 - Oxides of Nitrogen (NOX), Oxides of Sulfur (SO_x)
 - Ozone
 - Particulates
 - Photochemical Smog
 - Radon
 - Scrubbers
 - Toxic Air Contaminates(TAC)
 - Volatile Organic Compounds(VOC)
10. Review the concepts and definitions introduced in the lesson:

Suggestions for Development and Presentation

This lesson is designed to involve the student with all phases of air emission/pollutant regulation and control. Examples of air pollution control equipment and techniques, local regulations and inspection policies, monitoring and data gathering processes, etc. can be presented as points in the system where technicians might be employed.

Books

Global Warming: Are We in the Greenhouse Century?

Stephen H. Schneider 1989

Sierra Club Books

730 Polk St.

San Francisco, CA 94109

Pamphlets

Air Pollution Acid Rain and the Future of Forests

Worldwatch Paper #58

Sandra Postel 1984

Clearing the Air: A Global Agenda

Worldwatch Paper #94

Hilary F. French 1990

Worldwatch Institute

1776 Massachusetts Ave.

NW Washington, DC 20036

Calif. 2000: Exhausting Clean Air—Major Issues in Managing Air Quality

Joint Publications Office Assembly Office Research

State Capital #942849 Sacramento, CA 94249

Air Toxins CARB Program Update #1

The Air Pollution/Transportation Linkage

California Air Resources Board Office of Strategic Planning

P.O. Box 2815 Sacramento, CA 95812

Videos

The Air We Breathe: California Air Toxins

Calif. Air Resources Board

Clearing the Air

Clean Air Working Group

Air Pollution: Indoor

Films for the Humanities & Sciences

P.O. Box 2053 Princeton, NJ 08543

Inexpensive Newsletters

NATICH Newsletter (free)

National Air Toxins Information Clearing House

USEPA Environmental Protection Branch Research

Triangle Park, NC 27711

Air Issues Newsletter (free)

Chemical Manufacturers Association

2501 'M' St.

N.W. Washington, DC 20037 (202)887-1206

The Monitor Newsletter (free)

Gilian Instrument Corp.

8 Dawes Highway

Wayne, NJ 07470

Articles

Tougher Battles in the War on Smog

Golden State Report, pp 33-36

Hal Rubin, 11/1988

Should the Congress Adopt the 'Clean Air Act' Amendments of 1987

Congressional Digest, pp 42-64, 2/1989

Our Dirty Air

U.S. News and World Report, pp 48-54, 6/12/1989

A Series of Articles concerning Air Pollution

"Science Vol #24, 2110/1989

Articles from "National Geographic"

What's Happening to Our Climate Vol.150, #5,

November 1976

Are We Poisoning Our Air?

Vol.171, #4, April 1987

Schedule and Assignments

Lesson 7 can take 3 to 5 hours depending on how many "hands on" experiences the instructor wishes to provide, such as; reading through a local air quality management group's policy and strategy document, discussing example permit and report forms, exploring asbestos worker protection and monitoring, following the provisions of the "New" Clean Air Act through Congress, etc.

Suggested Test Questions and Answers

Questions:

1. How do the operational goals for Air Quality Standards and Emission Standards Differ?
2. Explain the difference between ozone at ground level and the ozone found in the stratosphere.
3. The only criteria pollutant that has not shown a significant drop

in the past decade is:

- a. Particulates
- b. SO₂
- c. CO
- d. Nitrogen oxide
- e. No answer, all of the above have been controlled

Answers:

- 1. Standards are goals, cut-off lines that allow one to judge how good or bad an area's air is compared to an adopted criteria.
- 2. O₃ at ground level is a part of the chemical mix that leads to photo-chemical smog. In the Stratosphere O₃ absorbs ultraviolet light.
- 3. d

8 Water/Soil Pollution

Intent and Approach

Lesson 8 provides an overview of basic geologic and hydrologic principles, covers significant chemical and physical processes that cause water pollution and describes the legislative and regulatory effort that has been put into place to assure the state of an ongoing supply of pure water.

Concepts presented in this lesson focus on applications that might be apart of a EHMT technician's assignment, such as: monitoring treatment of waste water, pollution abatement, the maintenance of equipment, gathering water quality data from test/monitoring wells, etc.

The requirements of the Federal and California Safe Drinking Water Act and the Clean Water Act are presented, along with other applicable laws that provide for the maintenance of a potable water supply. The kinds of processes, and equipment used to characterize and treat contaminated water are covered.

Lesson Objectives

To successfully complete this lesson the student will be able to:

- 1. List and comment on the phenomenon that make up the hydrologic cycle.
- 2. Discuss surface water sources and the water quality needed for a particular purpose.
- 3. Discuss groundwater as a source of pure water.
- 4. **Summarize** the main concepts used to explain how an aquifer's ability to deliver water correlates with its underground geology, recharge rate, water table depth, extent of its basin, etc.
- 5. **Outline** the kinds of standards applied to drinking water systems.
- 6. **Enumerate** the sources and processes by which surface water can become contaminated.
- 7. **Enumerate** the sources and processes by which groundwater can become contaminated.

Environmental Technology

8. **Describe** the principal provisions of the Safe Drinking Water Act, the Clean Water Act, Prop. 65 and the Porter -

Cologne Act.

9. **Give examples** of the kinds of treatment technologies that might be used to mitigate water supply contamination.

10. Define the relevant terms associated with hydrologic concepts and waterborne contamination, that were introduced

in the lesson (a vocabulary list is provided in Lesson Outline).

Lesson Outline

1. Inform your students as to the objectives of the lesson before beginning instruction.
2. Describe the processes which make up the “Hydrologic Cycle.”
3. Give an overview of surface water supplies:
 - Physical, chemical, and biological aspects.
 - Quality requirements of potential users.
 - Water rights.
4. Characterize the geologic and hydrologic phenomena associated with an aquifer:
 - How water is supplied to unsaturated and saturated zones.
 - Behavior of confined and unconfined aquifers.
 - Water table: overdrafting, recharging, etc.
5. Describe the sources and nature of surface water pollution:
 - Sewage, industrial discharges, agricultural runoff, etc.
6. Describe the sources and nature of groundwater contamination:
 - Spills, discharges to ground, etc.
 - Plumes: movement of contaminants into within aquifer.
7. List and describe the some prominent treatment technologies.
8. Refer to those laws that are concerned with regulating water supply contamination:
 - RCRA, CERCLA, Prop. 65, FWPCA, SDWA, Porter-Cologne
9. Discuss the main provisions of the Safe Drinking Water Act.
10. Discuss the main provisions of the Clean Water Act.
11. Point out the hands of management strategies that can be used to protect the state’s water supply:
 - UST control and monitoring.
 - Land bans.
 - Water conservation.
 - Waste site cleanup.
12. Go over any vocabulary words that have not yet been covered.
 - Activated Carbon Adsorption
 - Aeration, Air Stripping

Aquifer, Confined Aquifer, Unconfined Aquifer
Area Sources
BOD, COD
By-products
CERCLA
Clean Water Act(CWA)
Coliform
Contaminants
Disinfection Treatment
Effluent
Evaporation
Extraction
Federal Water Pollution Act(FWPA)
Groundwater, Surface Water
Hydrologic Cycle
In-Situ
Industrial Pretreatment, POTW Pretreatment Requirements
Infiltration
Leachate, Percolation
Maximum Contamination Level(MCL)
Monitoring Wells
NPDES Permits
Overdraft
Oxidation
Permeability
pH
Plume
Point Sources
Porter-Cologne Water Quality Act
Precipitation
Program (USTs), Underground Storage Tank
RCRA
Receiving Waters
Recharge
Regional Water Quality Control Board
Runoff
Safe Drinking Water Act(SDWA)
Safe Drinking Water and Toxic, Enforcement Act (Prop 65)
Saturated Zone, Unsaturated Zone, Vadose Zone

Sewage

State Water Resources Control Board

Surface Impoundments

Toxic Pits Cleanup Act(TPCA)

Transpiration

Water table

Water Quality Goals/Standards

12. Review the concepts and definitions introduced in the unit.

Suggestions for Development and Presentation

Lesson 8 tries to equip the beginning student with a basic understanding of the processes (physical, chemical and hydrological) which are involved in soil and water contamination. Biological and engineering techniques used to treat polluted water and soil are discussed. Many of the topics surveyed in this lesson are spoken to again in other courses within the EHMT curriculum.

An effort to create case studies of local aquifer and/or stream contamination should be made. The sources, nature of the contaminants, what has been done to treat the contamination, etc. can be explored.

Visuals (films, videos, overhead transparencies) are needed to illustrate the geologic and hydrologic concepts that are included in the less.

References and Resources

Articles

Water: Our Most Precious Resource

“National Geographic,” 8/80, p 144

Books

Planning for Groundwater Protection

G. William page

Academic Press, 1987

Booklets

Groundwater in California

State Water Resources Control Board

P.O. Box 100

Sacramento, CA 95801

(916)322-3132

Documents

Copy of Local Sewer District’s Use Regulations/Ordinances

Schedule and Assignments

Lesson 8 can take 4 to 6 hours depending on:

- The depth and detail used to explain the physical/ chemical/ biological/ hydrological principles involved with surface and groundwater protection and the legislation and regulation that pertains to the maintenance of drinking water quality.

- How much time is spent in class examining permit and reporting documents (Local Water Boards, POTWs, etc),

wellhead protection strategies, detection and testing methods, etc.

Student should read Chapter #7 “Groundwater” in the Griffin text.

Suggested Test Questions and Answers

Questions

1. Are the water quality criteria applied to agricultural use the same as those for human drinking water supplies? How

might they differ?

2. What processes and/or techniques might be used to cleanup a contaminated water source?

3. Toxic substances such as Pb, Sn, Hg, etc. are known as:

- a. Heavy metals
- b. Powerful COD compounds
- c. New wave rock groups
- d. Eutrophication chemicals
- e. None of the above

Answers:

1. Sanitation is an issue with potable water. Salinity is a problem for row crops.

2. Interceptor wells, barriers, chemical treatment (oxidation), precipitation, filtration, in-situ biological treatment, air/steam stripping, etc.

3. a

9 Hazardous Materials/ Waste Laws

Intent and Approach

The objective of this presentation is to give the beginning EHMT student an overview of relevant Federal and California environmental legislation.

The management of hazardous substances is examined in two ways:

1. The response requirements that apply to present industrial operations that might lead to the release of

toxic substances

into the environment.

2. The cleanup requirements that pertain to past practices that have lead to the contamination of air, soil and water.

The main provisions of California/Federal laws that seek to control polluting processes and to mitigate the effects of environmental contamination are reviewed.

A case history concerning the discovery and cleanup of a nearby Superfund site could be used to illustrate the application of a law's legislative intent to a "real world" situation.

Lesson Objectives

To successfully complete this lesson the student will be able to:

1. **Relate** a given law to the goals/directives it contains pertaining to the control of pollution sources or particular industrial processes, protection of a given environmental compartment, etc.
2. **Differentiate** between California and Federal legislation give an acronym (or jargon reference) to a given statute.
3. **Outline** the goals (areas of coverage, the protection provided, categories of hazardous materials dealt with, etc.) for:

RCRA/HSWA

HWCL

CERCLA/SARA

AB 2185

HMTA

HSM

TSCA

AB 1362/2013

FIFRA

AB 939

AB 1500

4. **Characterize** the nature of:

Land Bans (Land Disposal Restrictions)

A "cradle to grave" accountability system

RCRA Subtitle I: UST program

RCRA Subtitle D: State Solid Waste program

5. **Differentiate between** paired meanings:

Listed Wastes and Characterized Wastes

Generators And

Transporters

Small and Large Quantity Generators

Hazardous Material and Hazardous Waste

Landfill and Surface Impoundment

WET and TCLP

6. **Define** the terms introduced in the lesson (a vocabulary list is provided in Lesson Outline).

Lesson Outline

1. Discuss with the class the objectives and coverage of the unit before starting with its presentation.
2. Outline the main provisions of RCRA/HSWA and any associated State law(s). Emphasize the protection of the environment provided by; land bans, UST programs, waste reduction policies, municipal solid waste management plans, etc.
3. Outline the main provisions of CERCLA/ SARA. Stress the process by which cleanup priorities are established, liability categories defined by CERCLA, Community Right-to- Know provisions, etc.
4. Pull together a summary of those Federal laws that relate the requirements for treatment, transport, storage and disposal of hazardous wastes.
5. Cite the California laws that deal with the issues that correspond to those found within CERCLA/SARA, RCRA/HSWA (treatment, transport, storage and disposal of hazardous wastes, cleanup of contaminated sites, etc). Indicate the differences and overlaps that occur and where State law takes priority over Federal statutes. Emphasize the correlation between the Emergency Response Planning requirements of SARA Title III and California's AB 2185.
6. Discuss Solid Waste Management policies, as indicated in RCRA Subtitle D and California's SB 939.
7. Describe the areas of action and authority available to local jurisdictions concerning land use planning, air quality policies, hazardous materials ordinances, building/fire codes, etc.
8. Create a synopsis that summarizes all the legislation (State and Federal) that have been introduced into the course to this point.
9. Go over any vocabulary words that have not yet been covered:
 - AB 939
 - AB 2185, Business Plan
 - Characteristic Waste, Listed Waste
 - Chemical Inventory
 - Code of Federal Regulations (CFR)
 - Contingency/Emergency Plans
 - Corrosivity, Ignitibility, Reactivity, Toxicity
 - Cradle to Grave
 - Curbside Recycling
 - Department of Transportation (DOT)
 - Detoxification
 - Extremely Hazardous Substances
 - Form R: Toxic Chemical Release Report

Generators
Hazardous Materials Transportation Act(HMTA)
Incinerators
Land Bans
Liners
Manifests, Shipping Papers
Monitoring
Polychlorinated Biphenyls(PCBs)
Reporting Quantity
Recycling
SARA Title III
Threshold Planning Quantity
Transporters
Treatment, Storage and Disposal Facilities(TSDF)
Treatment, Treatment Standards
Volume Reduction, Waste Minimization
Waste Management Units

10. Review the references and vocabulary that were utilized in presenting this lesson of instruction.

Suggestions for Development and Presentation

Make an effort to not turn this lesson into a small version of University of California Davis' "Regulatory Framework" course. Select and present those major environmental laws/regulations that deal with critical issues, problems and national goals. It is not necessary to go into excessive detail.

Contrast the goals for "cleanup" legislation such as CERCLA to those typically set out for "control" efforts such as RCRA.

Local governmental units/agencies have become increasingly important to the application/enforcement of environmental regulations. Make contact with a county/city hazardous material control group in quest of hand out materials, copies of forms, quest speakers, etc.

References and Resources

Books

Hazardous Material Program Commentary: California
Specialty Technical Publishers, Inc.
Suite 101, 2034 "W" 12th Ave.
Vancouver B.C., Canada, V6J 2G2
Hazardous Waste Management Handbook

Hazard Communication Handbook

Prop. 65 Handbook

California Chamber of Commerce

P.O. Box 1736

Sacramento, CA 95812

Hazardous Materials Dictionary

Coleman, Ronny J. & William's, H. K.

Technomic Publishers, Inc., 1988

Prudent Practices for Handling Hazardous Chemicals in the Laboratory

National Academy Press, 1981

Handbook of Hazardous Waste Management for Small Quantity Generators

Phifer, Russell W. & McTigue, W. R.

Lewis Publishers, 1980

1990/1991 Hazardous Materials, Substances and Waste Compliance Guide

Hazardous Materials Publishing Company

243 West Main St.

Kutztown, PA 19530

Schedule and Assignments

This lesson can take from 5 to 6 hours of instructional time, especially if example forms are read to determine the requests they make for information and if exercises are devised that ask students to deal with the information needed for the completion of an example business plan.

The IOWA • regulations material is helpful as background to the instructor, but is too detailed for an introductory lesson.

Students can be referred to Chapter(s) #7 - #9 of the Griffin Text.

The book listed in References and Resources which is available from Hazardous Materials Publishing Company is a "one stop" compilation of most of the important Federal regulations.

Suggested Test Questions and Answers

Questions

1. In what way(s) are California's Hazardous Substance Accounting Act and CERCLA alike?
2. Municipal waste disposal is regulated under RCRA part:
 - a. Subtitle A
 - b. Subtitle C
 - c. Subtitle D
 - d. Subtitle I

e. None of the above RCRA only regulates hazardous wastes.

3. One of the Goals of RCRA is to reduce the amount of waste generated in the nation. Describe 3 process/management techniques by which this could be achieved.

Answers:

1. They both obtain monies from fines, permit fees and taxes on hazardous materials activities to establish an ongoing fund for the initial cleanup activities at a contaminated site.

2. b

3. Waste minimization, source reduction and recycling.

10 Industrial Hazardous Materials

Intent and Approach

This lesson characterizes the waste streams of some prominent California industries and the handling and record keeping requirements associated with them.

A proactive pollution prevention strategy aimed at reducing the volume of wastes generated and the amount of hazardous materials handled is described. The economic and environmental benefits derived from this approach are contrasted with the ‘end of the pipe’ tactics described in previous lessons.

The treatment, storage, transportation and disposal of hazardous materials is discussed. The DOT guidelines for packaging, labeling, documentation, etc., are dealt with in some detail and example report/ documentation forms are examined.

Lesson Objectives

To successfully complete this lesson the student will be able to:

1. Read example reporting and documenting forms and determine what information is being requested.
2. Describe major industrial uses of hazardous materials and possible methods for minimizing the resulting waste generation.
3. Recount the kind of paperwork employees of hazardous waste generators, transporters, and treatment/disposal facilities may become involved with.
4. Interpret the information available from the Hazardous Materials Table, such as, shipping paper and/or manifest content, packaging, and labeling requirements.
5. **Characterize** the procedures and needed data/information that are discussed in regulations pertaining to:
 - Incident/ release reporting requirements
 - DOT Shipping Papers/Manifesting
 - DOT Hazardous Materials Classes
 - DOT Marking/Labeling/Placarding regulations
 - Waste Reduction Strategies
6. Define the terms introduced in the lesson (a vocabulary list is provided in the Lesson Outline).

Lesson Outline

1. Inform the class of the lesson's objectives and content before beginning instruction.
2. Characterize the nature of some example waste streams and the compliance/accountability problems they introduce.
3. Discuss the incentives (disincentives?) for waste minimization/reduction/recycling programs. Contrast proactive waste management strategies with older 'end of the pipe' approaches.
4. Describe the process and techniques typically used in waste treatment.
5. Indicate the need for separating incompatible chemicals during storage and shipment.
6. Read through the DOT Hazardous Materials Table indicating the information concerning compatibility's, packaging/labeling/marketing requirements, transportation restrictions, etc.
7. Give some examples of alternative technologies that can be taken advantage of in recovering usable chemical stocks and/or reducing the amount of hazardous wastes a facility produces.
8. Go over any vocabulary words that have not yet been covered:

Alternative Technologies

Discharge, Spill

DOT Hazardous Materials Table

DOT/UN Number

Explosive, Flammable Liquid, Flammable Solid

Extremely Hazardous Substances

Hazardous Material, Hazardous Waste

Labels, Marking, Placard

Manifest, Shipping Papers

ORM, Poison

Release

Reportable Quantity, Reporting Requirements

SB 14(Roberti)

Small Quantity Waste Generator

Solid Waste

Source Reduction, Waste Minimization

Threshold Planning Quantity

Waste Stream

9. Review the concepts and definitions introduced in this lesson.

Suggestions for Development and Presentation

Typically this section of the course is the most applications oriented. For example, report forms, placards/ labels, waste profile information, manifests, shipping papers for hazardous materials, etc. can be brought into class and gone over in terms of what information is needed to "fill out" the required paperwork. Drawings and diagrams of treatment processes/equipment can be most helpful in giving students an

understanding of what is meant by “treatment”, “end of the pipe control”, “recover, reclaiming, recycling,” etc.

Schedule and Assignments

Lesson 10 can take from 3 to 4 hours of instructional time dependent on the effort made to deal with Department of Transportation Requirements, the kinds of technologies available for treatment of hazardous waste, the special problems the so called “small” generator has, and planning for a proactive waste minimization effort as called for in SB 14.

Suggested Test Questions and Answers

Questions

1. The Hazardous Materials Table CFR 49 lists information concerning:
 - a. Packaging requirements
 - b. DOT hazard classification
 - c. Labeling requirements
 - d. All of the above
 - e. None of the above
2. The difference(s) between a manifest and shipping papers.
3. List three of the five major types of waste treatments.

Answers:

1. d
2. A Manifest is necessary when shipping Hazardous Wastes. Shipping papers (bill of lading) are necessary for all commerce but require special notations when the shipment contains substances classed as Hazardous Materials.
3. Biological, chemical, incineration, fixation/immobilization, physical treatments.

11 Career Opportunities

Intent and Approach

This lesson is designed to unify all of the previous discussions of theory and application into a reality that provides the student with a recognition of his or her place in the environmental protection and regulatory compliance field.

Every occupational niche; public or private, desk work or field work, worker health or environmental protection, involved with cleanup or control, should be presented as a possibility for employment and/or

experience.

Necessary skills and requirements can be illustrated with actual job specifications, excerpts from newspaper want ads and the certification requirements needed to work hazardous waste site operations.

Lesson Objectives

To successfully complete this lesson the student will be able to:

1. **Enumerate** a specific set of skill competencies that he or she possesses and that could become the basis of a prospectus.
2. **Discuss** the scope of the environmental protection and regulatory compliance industry and the component businesses and agencies that would contain career opportunities that related to the student's training.
3. **Describe** the kinds of training required for certification of hazardous waste site workers, treatment-storage disposal workers, haulers of hazardous wastes, environmental auditors, etc.

Lesson Outline

1. Present a overview of the career fields available to the student within the EHMT field.
2. Describe the kinds of competencies employers expect by distributing and reading excerpts from job announcements. Highlight the skills and training needs identified by the surveys the consortium has conducted.
3. Acquaint the class with the form and content of a "good" resume and how they should conduct themselves during a job interview.
4. Review the various licenses and certificates that are required by Federal and State regulations for specialized situations within the industry.
5. Discuss the potential for further study and career development within the college's EHMT program, through courses at a nearby University of California Extension Center, or through the pursuit of a baccalaureate degree at a college campus.
6. Go over any vocabulary words that have not yet been covered: Advocacy Groups

Asbestos

Abatement

Career Changes

Chem-Tech

Community Relations PR

Computer Usage Technician

Conservation

Consulting Firms

County/City Inspectors

Ecosystem Restoration

Federal Job Information Centers

Environmental Technology

Hazardous Materials Management
Incinerator Operations
Industrial Hygiene Industry Associations
Internships—Career Oriented
Job Opportunities
Legislative Aids
Lobbyists
Natural Resources Management
Paraprofessionals
Peace Corps
Private Sector
Public Health
Public Sector
Recycling Centers
Resume Writing
Salaries
Solid Waste Management
Specialists
Training Requirements
Trends

Suggestions for Development and Presentation

This session should instill the student with enthusiasm for and commitment to the pursuit of a career in the environmental field. An EHMT background can lead to employment in an extremely varied set of jobs and the students should leave with the belief that they can prepare themselves for almost all of them.

A good way to foster a discussion of career planning is to arrange for a personnel director from local industry or a human resource specialist from a state agency to speak to the class.

Share with the class all announcements of major hazardous materials conferences that might have a “Job Fair”, “Employment registration”, or “Job Exchange” type program going on. Try to develop a list of employers for your area; public/private sector, consulting/engineering firms, nonprofit/volunteer, local county/city. Almost any contact you make can become a source of information concerning employment.

Schedule and Assignments

This lesson takes about 1 - 2 hours depending on whether or not a guest speaker is invited and whether a moderate amount of time is devoted to a discussion of job announcements, resumes, contact lists, needed skills, etc.

Basics of Toxicology

Instructor's Guide

Prepared By:

Steven Fink
Director of the EHMT Program
West Los Angeles College
4800 Freshman Drive
Culver City, CA 90230
(213)836-7110, ext. 237

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Basics of Toxicology

Module Description

This module presents the basics of toxicology and its applications to Risk Assessment studies. Topics include a discussion on exposure and entry routes, fates of toxic substances in the body (toxicokinetics), concepts in experimental toxicology, the dose response relationship, actions of toxic substances, target organ effects, the actions and types of carcinogens, and a survey of the health effects of common classes of toxic substances is also presented. The principles of Risk Assessment, as well as sources of information on toxic substances is also presented.

The competencies fulfilled by this course are:

I. Hazardous Materials Handling and Sampling

- A. Handles hazardous materials/wastes
 - 1. Identifies, selects, and recommends safety equipment

II. Procedures and Plans for Regulatory Compliance

- A. Assists in development of organizational goals and prevention plans with relation to hazardous materials/wastes and safety
- B. Tracks regulatory compliance
 - 1. Procures current MSDS's
 - 2. Understands and utilizes information on MSDS's

Specific objectives are listed for each of the 12 lessons described in this module.

Texts

Suggested Student Text:

Excerpts from the various sources described in the lessons.

Environmental Technology

Instructor Resources and References are described within this document as well.

Instructor Note

Note to Instructors: It is suggested that the instructor using this module read through **all** lessons prior to starting the course. In this way, later concepts which are built on earlier activities can be better anticipated and planned for

Module

Description

Texts

Instructor

Note

Preface

Preface

This is the instructor's guide for a module entitled *Basics of Toxicology*.

This module is part of *Health Effects of Hazardous Materials*, a 3 unit lecture core course in the EHMT Associate Degree and Certificate Program. The course is designed to provide students with instruction in principles of toxicology and industrial hygiene.

The course has been divided into three modules:

- **Module I Basics of Toxicology (2 units)**
- **Module II Basics of Industrial Hygiene (1 unit)**

This modularization has been designed in such a way that the course can be taught as two separate courses. Module I is 36 hours and therefore represents 2 units. Module II is 18 hours and therefore represents 1 unit.

Modularization will allow the maximum flexibility for individual colleges to meet both traditional educational goals **and** the immediate needs of local industry. This flexibility is evidenced by the following available options, since the modules can be used in whole or part for:

- **Contract Education**
- **Community Service Classes**
- **Degree and Certificate Applicability**

Note to Instructors: It is suggested that the instructor using this guide become entirely familiar with the lesson plan and student materials prior to starting the course. Changes should be made as needed to reflect current regulations.

Basics of Toxicology

Intent and Purpose

This module presents the basics of toxicology and its applications to Risk Assessment studies. Topics include a discussion on exposure and entry routes, fates of toxic substances in the body (toxicokinetics), concepts in experimental toxicology, the dose response relationship, actions of toxic substances, target organ effects, the actions and types of carcinogens, and a survey of the health effects of common classes of toxic substances is also presented. The principles of Risk Assessment, as well as sources of information on toxic substances is also presented.

The competencies fulfilled by this course are:

I. Hazardous Materials Handling and Sampling

A. Handles hazardous materials/wastes

1. Identifies, selects, and recommends safety equipment

II. Procedures and Plans for Regulatory Compliance

A. Assists in development of organizational goals and prevention plans with relation to hazardous materials/wastes and safety

B. Tracks regulatory compliance

1. Procures current MSDS's
2. Understands and utilizes information on MSDS's

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Excerpts from the various sources described in the lessons.

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Environmental Technology

Lesson 1 — Introduction to Toxicology*

Lesson 2 — Exposure and Entry Routes*

Lesson 3 — Distribution, Metabolism, Elimination*

Lesson 4 — Experimental Toxicology & Dose-Response*

Lesson 5 — Action of Toxic Substances*

Lesson 6 — Target Organ Effects*

Lesson 7 — Reproductive Toxins, Mutagens, Carcinogens*

Lesson 8 — Survey of Common Toxic Substances*

Lesson 9 — Survey of Common Toxic Substances*

Lesson 10 — Risk Assessment*

Lesson 11 — Clinical Symptoms & Treatment of Toxicity*

Lesson 12 — Sources of Information on Toxic Substances*

* Supplemental Instructor & Student Materials Follow

Introduction to Toxicology and Sources of Information

Intent and Purpose

In this lesson, the student is introduced to the science of toxicology. A distinction is made between a hazardous material and a toxic substance. A distinction is also made between concentration and the total dose of a toxic substance. Total dose is the product of the concentration and the exposure.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Distinguish** between a hazardous material and a toxic substance.
2. **Explain** the differences between the exposure to toxic substances in actual work settings and how experimental animals are exposed in toxicological studies.
3. **Define** the following:
 - Dose
 - Chemical Concentration
 - Exposure Time
4. **Describe** the units total dose is commonly expressed in for ingestion, dermal absorption, and inhalation.

Lesson Outline

1. The lesson is introduced with a definition of toxicology, including a distinction between a hazardous material and toxic a substance.
2. Common occasions of exposure to toxic substances is considered, including:
 - Process Operations involving hazardous materials, like welding, machining, plating, spray coating, using cleaning solvents, etc.
 - Maintenance activities at sites of hazardous materials.
 - Process upsets and releases of toxic substances.
 - Indoor and outdoor air pollutants.
 - Drinking water contamination.
 - Use of pesticides.
3. An introduction to some of the terminology and units used in toxicology is presented, including:
 - dose

- chemical concentration
- exposure time

- mg/Kg & mg/Kg-Day

- mg/m² & mg/m²-Day

- mL/L & mL/L-Day

- mg/m³ & mg/m³-Day

- ppm & ppm-Day

- fibers/cm³ & fibers/cm³-Day

Suggestions for Development and Presentation

A source of confusion is the inconsistent use of the terms “hazard”, “hazardous material”, and “toxic substance”. I would suggest the following:

A *hazard* is anything having the capacity to cause physical damage (ex: cause a fire to a building) or harm the health of living organisms.

A *hazardous material* refers to any chemical substance or agent (ex: a microorganism) that poses a physical and/or health hazard.

Those chemical substances or agents (hazardous materials) that have the potential to harm the health of living organisms are called *toxic substances*. Toxic substances are thus a subset of hazardous materials.

The difference between the total dose of a toxic substance and its concentration should be distinguished. The total dose is the product of the concentration and the exposure.

References and Resources

Also read: “Industrial Toxicology” (chap. 15) and “Appendix A; Sources of Help”, pp. 727-765 from: B. Plog; *Fundamentals of Industrial Hygiene*; National Safety Council; 3rd ed (1988); available from National Safety Council; Order Processing; 1815 Landmeier Road; Elk Grove Village, IL 60007-2420; (800) 621-7619 available from ACGIH; catalog no: 0670; 6500 Glenway Ave.; Bldg. D-7; Cincinnati, OH 45211; (513) 661-7881

Also see Chaps. 1 & 2 in: P. Williams & J. Burson; *Industrial Toxicology; Safety and Health Applications in the Workplace*; Van Nostrand Reinhold, Pub.; New York; 1985 }

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Exposure and Entry Routes

Intent and Purpose

In this lesson, the student will be introduced to some of the more common occasions of hazard exposure, as well as the most common routes of exposure and entry into the body. A distinction is made between a hazardous material versus the absorption of a toxic substance into the body. This provides the basis for differentiating between the local effects produced by a hazardous material and any toxic effects that may develop systematically. For each of the principal routes of exposure (viz: the gastrointestinal system, the skin, the eyes, and the respiratory system), there is a brief review of its functional anatomy. Following review of each route, the most common clinical effects produced by exposure to hazardous materials is cited. The principal goal of this lesson is for the student to learn the principal routes of exposure, their differences, and some of the typical health effects produced from exposure to hazardous materials by these routes.

Lesson Objectives

To successfully complete this lesson, the student will be able to :

1. Explain the difference between “exposure” to a hazard and the “absorption” of a toxic substance.
2. Explain the difference between a “local effect” and a “systemic effect”.
3. Identify the principal factors that affect the rate of systemic absorption.
4. Identify the most common hazard exposure routes.
5. Rank the exposure routes:
 - based on their frequency
 - based on their potential for systemic absorption
 - based upon their potential toxicity
6. Identify the principal parts of the Digestive System and explain their function(s).
7. Identify the types of effects that can occur after ingesting a toxic substance.
8. Identify the principal functions of the skin.
9. Identify the principal types of local effects on the skin
10. List 4 factors that determine the severity of a chemical burn.
11. Identify the principal parts of the eye and explain their function(s).
12. Identify the principal types of local effects on the eye.

13. Identify the principal parts of the Respiratory System and explain their function(s).
14. Identify the principal types of local effects of the Respiratory Tract.
15. Explain the difference between simple asphyxiation and chemical asphydation, and provide an example of each.
16. Define the following terms: Fibrosis; eduma; ulceration; defatting agent necrosis; narcosls
17. Identify the principal types of airborne hazardous substances
18. Explain why only particles between .5 the 5mm in length are of primary concern.

Lesson Outline

1. The principles of human exposure to toxic substances & their entry routes into the body are presented, including a consideration of:
 - Local versus systemic effects
 - Factors that affect the rate of systemic absorption
2. The ingestion of toxic substances is considered, including:
 - Review of the principal functions of the digestive system
 - Review of the functional parts of the digestive system
 - Local effects on the alimentary cannell
 - Systemic absorption of toxins substances
3. Skin contact of toxic substances is reviewed , including :
 - Review of the principal functions of the skin
 - Review of the basic anatomy of the skin
 - Local effects on skin:
 - cutaneous absorption
4. Exposure of the eyes to toxic substances is considered, including:
 - Review of the functional parts of the eyes
 - Local effects of the eyes
 - Systemic absorption

5. The inhalation of toxic substances is considered , including:

- Review of the principal functions of the respiratory system
- Review of the functional parts of the respiratory system
- Types of airborne contaminants
- Local effects on the respiratory tract
- Systemic absorption

Suggestion for Development and Presentation

It is important to emphasize how the physical state of the hazardous material determines the most likely exposure route(s). It is also important to clearly distinguish between exposure to a hazardous material, and its systemic absorption into the bloodstream. It is possible that exposure to a very toxic substance might be poorly absorbed and produce only local effects. It is also possible that another hazardous material might be less toxic, but rapidly absorbed, producing both local and systemic effects.

Before considering the factors that can affect the rate of systemic absorption of a substance, I would suggest briefly reviewing the basic structure of (cell) membranes. Specifically, mention should be made that membranes are fatty in nature (composed principally of phospholipids), This should aid in the student's understanding of how the "lipid-solubility" of a substance affects its rate of absorption.

The instructor should encourage students to suggest which types of toxic substances would be most commonly absorbed by the different routes, as well as present examples. It is important to emphasize however, that it is the concepts and principles that students should be learning rather than long lists of esoteric chemicals

References and Resources

Sources of Potential Exposure

- Read: "Material and Their Characteristics", Chap. 2 from :L.V Cralley & L.J. Cralley; In- Plant Practices for job Related Health Hazards Control; vol 2: Engineering Aspects-: John Wiley & Sons; 1989; (800) 225-5945

Exposure & Entry Routes

- See Lesson 2; Routes of Entry and Target Organs: pp 2-9 to 2-45 and 2-53 to 2-56 of HMTRI; Course HMT 280; Hazardous Materials Health Effects: 1988
- Read pp 11-20, Section II; pp 78-100 , Section IV; and pp102-120 , Section V in; M, Key et al : Occupational Diseases; A Guide to Their Recognition; U.S. Dept. of Health Education, and Welfare; DHEW Pub. No. (NIOSH) 77-181, 1977

Read "Principals of Toxicology" in : EPA Training Manual 165.5 : hazardous Materials Incident Response Operations; available from ACGH; catalog no : 3110; 6500 Glenway Ave.; Bldg. D-7; Cincinnati, OH 45211; (513) 661-7881

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- Also see Chaps. 3,8 &9 in : P. Williams & J Burson; Industrial Toxicology; Safety and Health Applications in the Workplace; Van Nostrand Reinhold Pub.; New York 1985
- Also See Chaps. 2,3,5,7,8,14,& 15 in : B. Plog; Fundamentals of Industrial Hygiene; National Safety Council; 3rd ed (1988); available from National Safety Council; Order Processing : 1815 Landmeier Road; Elk Grove Village, IL 60007-2420; (800) 621- 7619 available from ACGIH; catalog no; 0670; 6500 Glenway Ave., Bldg. D-7 Cincinnati, OH 45211; (513) 661-7881

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/ study assignments are:

Lesson 2; Routes of Entry and Target Organs; pp. 2-9 to 2-45 and 2-53 to 2-56 of HMTRI: Course HMT 280 : Hazardous Materials Health Effects

Pages 11-20, Section II; pp. 78 to 100, Section IV; and pp. 102-120, Section V in :M Key et. al; Occupational Diseases ; A Guide to Their Recognition

Distribution, Metabolism& Elimination of Toxics

Intent and Purpose

In this lesson the basic principles of how a toxic substance moves through the body (“toxicokinetics”) are presented. This includes consideration of how the physical and chemical properties of a substance affect its uptake into the bloodstream, in which organs in the body it tends to accumulate, and how it is eliminated from the body. Consideration for how certain underlying illnesses can affect the severity of the toxic reaction is also given.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Identify** the principal factors that affect the distribution of a toxic substance in the body.
2. **Explain** what is meant by the “blood-brain-barrier”.
3. **Differentiate** between a toxic substance’s site of action and the inactive sites of accumulation.
4. **Explain** the function of making a toxic substance more water-soluble in a detoxification reaction.
5. **Define** the following terms: target organ; reservoir site; polyuria; uremia; anemia; clearance test; biliary secretion.
6. **Differentiate** between a Phase I (“destructive”) reaction and a Phase II (“conjugation”) detoxification reaction.
7. **Explain** what is meant by a “bioactivation” reaction.

8. **List** what factors could affect the rate of metabolism of a toxic substance.
9. **Differentiate** between acute liver damage and chronic liver damage.
10. **Explain** how the kidney acts to remove toxic substances from the bloodstream, and what factors affect its ability to do so.

Lesson Outline

1. The lesson is introduced with a series of questions: “What happens to a toxic substance after it enters the body? Where does it go? Can it be eliminated? And if so, then how?”
2. The distribution of a toxic substance through the body is discussed, including a consideration of the following factors:
 - route of exposure
 - blood perfusion at the site of exposure
 - lipid-solubility of the toxic substance
 - binding to plasma proteins
 - anatomic barriers
 - sites of bioaccumulation, including both sites of action (“target organs”) and inactive sites (“reservoirs”)
3. The metabolism (biotransformation) of toxic substances is discussed, including:
 - the liver’s role as the principal site of metabolism
 - the types of detoxification reactions, including destructive reactions and conjugation reactions
 - bioactivation reactions
 - factors that affect the rate of metabolism, including age, liver disease, and chemical tolerance by enzyme induction.
4. The excretion of metabolites is discussed, including the role and function of:
 - the kidneys
 - the lungs
 - biliary secretion
 - sweat & saliva
 - mother’s milk

5. The half-life of a toxic substance is defined, and consideration is given to the factors that would affect the half-life and the resulting consequences.

Suggestions for Development and Presentation

There are two principal concepts that should be emphasized in this lesson. First, is an appreciation for how the body handles toxic substances in general, from the point of uptake to the point of elimination. Second, is an appreciation for how the particular physical and chemical properties of the toxic substance determine the specifics of how it is handled by the body. The specifics for each toxic substance include the rates of uptake & elimination, what the target organ is, how is it metabolized, and how is it excreted. Examples of different toxic substances, and how they are handled differently by the body should be given to clarify this point for the student.

References and Resources

See Lesson 2: “Routes of Entry and Target Organs”; pp. 2-21 to 2-24; pp. 2-66 to 2-67; pp. 2-46 to 2-52; pp. 1-15 to 1-17 of HMTRI; Course HMT 280; *Hazardous Materials Health Effects*; 1988

See pp. 25 to 41; Section II in: M. Key, et. al; *Occupational Diseases; A Guide to Their Recognition*; U.S. Dept. of Health, Education, and Welfare; DHEW Pub. No. (NIOSH) 77-181; 1977

Also read Chaps. 3, 5, & 6 in: P. Williams & J. Burson; *Industrial Toxicology; Safety and Health Applications in the Workplace*; Van Nostrand Reinhold, Pub.; New York; 1985

Read “Principles of Toxicology” in: EPA Training Manual 165.5: *Hazardous Materials Incident Response Operations*; available from ACGIH; catalog no: 3110; 6500 Glenway Ave.; Bldg. D-7; Cincinnati, OH 45211; (513) 661-7881

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments are:

Students should read the appropriate pages in the HMTRI; Course HMT 280; *Hazardous Materials Health Effects* text before the lecture.

Students should read the appropriate pages in *Occupational Diseases; A Guide to Their Recognition*

Experimental Toxicology & the Dose-Response Relationship

Intent and Purpose

In this lesson, the student is introduced to the terminology and methodology used in experimental toxicology, especially using animals. The factors that affect the toxicity of a substance, as well as the factors that affect the variations in the response to a given substance are covered. The threshold theory of toxicity is presented, and those effects (such as cancer) that may not exhibit thresholds are briefly considered at this time, to be further developed later (under risk assessment). Finally a consideration of the three types of animal studies is covered, including some of the ways these studies differ from “real-world” human exposures.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Describe** the Dose-Response Relationship.
2. **Explain** the variations in response within the population.
3. **Describe** how the relative toxicity of substances is most commonly expressed.
4. **List** 5 factors that affect a substance's toxicity.
5. **Explain** the Threshold Concept.
6. **Define** the following: toxicity, threshold dose, NOEL, LD₅₀
7. **Identify** which toxic responses may not exhibit thresholds.
8. **How** is cancer experimentally identified in animal studies?
9. **Explain** the differences in the responses commonly observed following an acute exposure and chronic exposure to a toxic substance.
10. **Explain** why higher doses of a toxic substance must be used in animal experiments in order to statistically determine the responses that would occur in a larger population.

Lesson Outline

1. The three main types of animal studies are presented, including the examination of:
 - Acute Exposures & the types of responses that occur
 - Subchronic Exposures & the types of response that occur
 - Chronic Exposures & the types of responses that occur
 - Differences between animal studies and “real-world” exposures
2. The Dose-Response Relationship is presented, including:
 - a description of a Dose-Frequency Response Curve (normal distribution)
 - a description of a Dose-Cumulative Response Curve

3. The definition of toxicity (toxic potency) and the acute LD_{50} are presented, and the factors that affect a substance's toxicity are considered, including:

- the chemical properties of the toxic substance
- the physical state of the toxic substance
- the route of entry into the body
- the duration of exposure to the toxic substance
- the frequency of exposure to the toxic substance
- the sensitivity of the individual to the toxic substance

4. The Threshold Theory of Toxicity is presented, including a description of the Threshold Dose (TD_{LO} ; LOAEL) and the No Observed Effect Level (NOEL).

5. The toxicity of essential nutrients is considered.

6. The toxic responses that may not exhibit thresholds are considered, including the experimental identification of cancer:

- the presence of types of tumors not seen in controls
- the increase in the incidence of tumor types occurring in controls
- the development of tumors earlier than in controls
- an increase in tumors in various organs
- the Ames Test

7. Types of toxicological studies are considered:

- Typical protocols used in animal toxicity studies
- Clinical studies
- Epidemiologic studies
- Plant and wildlife studies

8. The problems with extrapolating toxicological data from animals to humans is considered.

Suggestions for Development and Presentation

It should be emphasized that any given toxic substance produces a series of dose-response curves: at the lowest end, the response might be irritation (showing a bell-shaped curve distribution based on differential sensitivity to the substance), followed by a second dose-response curve reflecting headache & nausea. This might be followed by a third bell-shaped distribution showing narcosis (drowsiness) in response to a yet higher dose. Each bell-shaped response typically overlaps with the next one, reflecting the differences between the most sensitive and the least sensitive (affected) individuals.

Both a Dose-Frequency Response Curve (normal distribution) and a Dose-Cumulative Response Curve, reflecting the cumulative percent increase of the affected population as the dose is increased. Indeed, it is the latter curve that is most commonly drawn when describing dose-response relationships. The LC_{50} is used to express the lethal airborne level, and an aquatic LC_{50} is used to express the lethal level for fish or other aquatic organisms, such as in aquatic toxicity test described under CCR §66696.

It should be emphasized that the LD_{50} is used to express the relative lethal toxicity, but tells you nothing about the non-lethal toxic effects.

It might be useful to mention that exposure guidelines (such as the Threshold Limit Values (TLV's)) used by governmental agencies are in essence like the NOEL's observed in experimental animals.

There are significant differences between animal studies and "real-world" exposures, as well as some important assumptions that are made in the designing of the experiments and the extrapolating of the

Suggestions for Development and Presentation

Suggestions for Development and Presentation

(Continued)

data. For example, although most exposures to toxic substances in industrial settings are by inhalation or skin contact, in most experimental studies the toxic substance is administered orally. Secondly, when only small numbers of animals are used in an experimental study, higher doses of the toxic substance must be used to statistically "force" comparable results to what would occur in a much larger population (consider: if a dose actually caused a response in 1/200, but only 100 test animals were used, it is possible the experimenter would not observe any toxic responses in the study!)

Thirdly, the human population is more heterogeneous than the experimental animal populations, & thus contain individuals who are probably more sensitive.

Differences, such as these, are the heart of the "Risk Assessment" controversies.

References and Resources

See Lesson 1: "Risk Assessment"; pp. 1-15 to 1-30 of: HMTRI; Course HMT 280; *Hazardous Materials Health Effects*; 1988

Also read: "Industrial Toxicology" (chap. 15) from: B. Plog; *Fundamentals of Industrial Hygiene*; National Safety Council; 3rd ed (1988); available from National Safety Council; Order Processing; 1815 Landmeier Road; Elk Grove Village, IL 60007-2420; (800) 621-7619 available from ACGIH; catalog no: 0670; 6500 Glenway Ave.; Bldg. D-7; Cincinnati, OH 45211; (513) 661-7881

Environmental Technology

See: *Toxicology: The Science of Poisons* (Pub. #21221); ANR Publications; University of California; 6701 San Pablo Ave.; Oakland, CA.94608-1239; (415) 642-2431

Read “Principles of Toxicology” in: *EPA Training Manual 165.5: Hazardous Materials Incident Response Operations*; available from ACGIH; catalog no: 3110; 6500 Glenway Ave.; Bldg. D-7; Cincinnati, OH 45211; (513) 661-7881

See “Toxicity Hazards of Chemical Substances”, chap. 6 from the *FEMA/US DOT/US EPA Handbook of Chemical Hazard Analysis Procedures*; 1989; (301) 447-1068

Also see Chaps. 3, 5, & 6 in: P. Williams & J. Burson; *Industrial Toxicology; Safety and Health Applications in the Workplace*; Van Nostrand Reinhold, Pub.; New York; 1985 }

This lesson is suggested to take 3 hours of classroom instruction.

Schedule and Assignment

Student reading/study assignments are:

Pages 1-15 to 1-30 of Lesson 1: “Risk Assessment” in the HMT 280; *Hazardous Materials Health Effects*

“Toxicology: The Science of Poisons” (Pub. #21221); ANR Publications; University of California

“Principles of Toxicology” in: *EPA Training Manual 165.5: Hazardous Materials Incident Response Operations*

Action of Toxic Substances

Intent and Purpose

In this lesson the student is introduced to the way toxic substances directly act on the body. Further, since most exposures are to numerous toxic substances, consideration is given to types of interactions between toxic substances (with respect to effects on the body).

Lesson Objective

To successfully complete this lesson, the student will be able to:

1. **Explain** the two types of direct actions a toxic substance can have on the body.
2. **Define** the following types of interactions between toxic substances:

- additive
- synergistic
- potentiation

- antagonistic
- sensitizing

Lesson Outline

1. The lesson is introduced with a consideration of how Toxic Substances act on the body, including examples of:

- Direct physical actions
- Chemical interactions at specific receptor sites
- Stimulating Agents (Agonists)
- Blocking Agents (Antagonists)
- Enzyme Inhibitors

2. The types of interactions that may occur between toxic substances is reviewed, including: additive, synergistic, potentiation, antagonistic, and sensitizing.

Suggestions for Development and Presentation

Specific examples should be presented of the actions and interactions that of toxic substances. However, the purpose of this lesson is not to have the student learn these actions for a multitude of specific toxic substances, but to understand the types of actions that can occur.

The reason for describing interactions between toxic substances is because most exposures are not to a single toxic substance, but to numerous substances. This is because individuals are exposed all the time to various substances in the air, water and food. Furthermore, most toxic substances encountered do not consist of a single entity, but a mixture of substances. For example, a typical solvent may contain one or more chlorinated hydrocarbons plus an alcohol. Part of the uncertainty in effect to a given toxic substance, is associated with possible interactions that may occur with exposure to additional substances.

References and Resources

See pp. 22-26; Section II: M. Key, et. al; *Occupational Diseases; A Guide to Their Recognition*; U.S. Dept. of Health, Education, and Welfare; Pub. No. (NIOSH) 77-181; 1977

Also read: "Industrial Toxicology", pp. 359-365 (chap. 15) from: B. Plog; *Fundamentals of Industrial Hygiene*; National Safety Council; 3rd ed (1988); available from National Safety Council; Order Processing; 1815 Landmeier Road; Elk Grove Village, IL 60007-2420; (800) 621-7619 or available from ACGIH; catalog no: 0670; 6500 Glenway Ave.; Bldg. D-7; Cincinnati, OH 45211; (513) 661-7881

See Lesson 2: Routes of Entry and Target Organs; pp. 2-21 to 2-24; pp. 2-66 to 2-67; pp. 2-46 to 2-52 of HMTRI; Course HMT 280; *Hazardous Materials Health Effects*; 1988

See: *Toxicology: The Science of Poisons* (Pub. #21221); ANR Publications; University of California; 6701 San Pablo Ave.; Oakland, CA.94608-1239; (415) 642-2431

Environmental Technology

Read “Principles of Toxicology” in: *EPA Training Manual 165.5: Hazardous Materials Incident Response Operations*; available from ACGIH; catalog no: 3110; 6500 Glenway Ave.; Bldg. D-7; Cincinnati, OH 45211; (513) 661-7881

Also see Chaps. 3 in: P. Williams & J. Burson; *Industrial Toxicology; Safety and Health Applications in the Workplace*; Van Nostrand Reinhold, Pub.; New York; 1985

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments are:

Pages 22 to 26; Section II in: M. Key, et. al; *Occupational Diseases; A Guide to Their Recognition*.

“Industrial Toxicology”, pp. 359-365 (chap. 15) from: B. Plog; *Fundamentals of Industrial Hygiene*.

Target Organ Effects

Intent and Purpose

In this lesson, the student will be introduced to the principal sites (target organs) that toxic substances effect after systemic absorption.

For each target organ, its general organization and functions are briefly reviewed. This should give students the background of normal function so that they will better understand the specific consequences of toxic substances on the target organs.

The specific toxic substances identified that can cause a toxic disease are cited only as examples, and are not intended to necessarily be memorized.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Describe** the function of the heart, including:

- the role of the electrical impulse in synchronizing the heart beat
- the effect of cardiotoxins on the electrical pattern of the heart

2. **Describe** the nervous system, including:

- the general organization
- the Blood-Brain Barrier
- the 3 functional categories of neurons

- the symptoms associated with narcosis
- the 3 types of neural damage caused by neurotoxins, and the clinical manifestations

3. **Describe** the liver, including:

- the principal functions of the liver
- the clinical symptoms of toxic hepatitis
- the most common types hepatotoxins
- medical diagnosis of toxic hepatitis

4. **Describe** the kidney, including:

- the principal functions of the kidneys
- the clinical symptoms of renal failure
- the most common types of nephrotoxins

5. **Describe** the blood, including:

- the general composition of whole blood
- the principal types of “formed elements” and their functions
- the role of blood platelets
- the types of hemotoxins and their effects

6. **Describe** the immune system, including:

- the general functions of the immune system
- the functional components of the immune system and their roles in the immune response
- the effects of immunotoxins on the immune response

Lesson Outline

The lesson is introduced with a definition of “target organ” as the principal site(s) where a toxic substances produces its effect after systemic absorption.

1. The heart is presented, including:

- Review of its functional anatomy

- Effects of cardiotoxins
- Clinical symptoms of cardiac arrhythmias

2. The nervous system is presented, including:

- Review of the general organization of the nervous system
- Review of the functional structure and types of neurons
- Effects of neurotoxins
- Clinical symptoms of neurotoxicity

3. The liver is presented, including:

- Review of the principal functions of the liver
- Effects of hepatotoxins
- Clinical symptoms of liver damage
- Examples of hepatotoxic substances

4. The kidney is presented, including:

- Review of the principal functions of the kidneys
- Effects of Nephrotoxins
- Clinical symptoms of kidney damage
- Examples of nephrotoxic substances

5. The blood is presented, including:

- Review of the components of whole blood
- Review of the functions of red blood cells
- Review of the functions of white blood cells
- Review of the functions of blood platelets
- Effects of hemotoxins
- Clinical symptoms of hemotoxicity
- Examples of hemotoxic substances

6. The immune system is presented, including:

- Review of the general functions of the immune system
- Functional components of the immune system
- Effects of immunotoxins
- Clinical symptoms of immunotoxicity

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments are:

Lesson 2: Routes of Entry and Target Organs; pp. 2-21 to 2-92 of HMTRI; Course HMT 280; *Hazardous Materials Health Effects*.

“Principles of Toxicology” in: EPA Training Manual 165.5: *Hazardous Materials Incident Response Operations*.

Reproductive Toxins, Mutagens, and Carcinogens

Intent and Purpose

In this lesson, the student will be introduced to the principal sites (target organs) that toxic substances effect after systemic absorption.

For each target organ, its general organization and functions are briefly reviewed. This should give students the background of normal function so that they will better understand the specific consequences of toxic substances on the target organs.

The specific toxic substances identified that can cause a toxic disease are cited only as examples, and are not intended to necessarily be memorized.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. ***Describe*** the Reproductive System, including:

- the principal functions of the Male Reproductive System and the potential effects of toxic substances
- the principal functions of the Female Reproductive System and the potential effects of toxic substances

2. ***Describe*** the effects of Fetal Toxins, including:

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- the differences between embryotoxicity, congenital malformations, growth retardation, and mental retardation
- the effects of prenatal carcinogens

3. **Describe** the effects of Mutagens, including:

- the difference in consequences between somatic cell mutations and reproductive cell mutations
- the difference between genetic point mutations and chromosomal alterations

4. **Describe** the effects of Carcinogens, including:

- the normal rate of cancer in the population
- the characteristics of cancer
- the difference between benign and malignant tumors
- the difference between initiator and promoter types of carcinogens
- the carcinogens associated with Lung Cancer
- the carcinogens associated with Urinary Bladder Cancer
- the carcinogens associated with Liver Cancer
- the carcinogens associated with Leukemia
- the carcinogens associated with Skin Cancer
- the treatment of cancer

Lesson Outline

1. The lesson is introduced with the Reproductive System, including:

- Review of the Male Reproductive System
- Effects of Male Reproductive Toxins
- The Effects of Female Reproductive Toxins
- Effects of Female Reproductive Toxins

2. The Effects of Fetal Toxins is presented, including:

- Embryotoxicity

- Congenital malformations
- Growth retardation
- Mental retardation
- Prenatal carcinogens

3. The Effects of Mutagens are presented, including:

- Change in the DNA
- Somatic versus reproductive cell mutations
- Types of DNA changes
- Chemical mutagens
- Types of ionizing radiation

4. The Effects of Carcinogens are presented, including:

- The description of cancer
- Types of carcinogens
- Sites of cancer
- Examples of cancer
- Clinical symptoms of cancer
- Treatment of cancer

Suggestions for Development and Presentation

The instructor presenting this material should be knowledgeable in the anatomy & physiology of the human reproductive system, cell biology and cancer. Any nursing "anatomy & physiology" textbook would serve as a useful reference source. A somewhat simpler, but very useful textbook is *Human Biology* by Sylvia Mader (Wm. C. Brown, Publisher). Another excellent reference for the instructor would be C. Kupchella; *Dimensions of Cancer* (Wadsworth Pub.) for a straightforward presentation of all facets of cancer.

The specific toxic substances identified that can cause a toxic disease are cited only as examples, and are not intended to necessarily be memorized.

References and Resources

Read: Lesson 2: Routes of Entry and Target Organs; pp. 2-21 to 2-92 of HMTRI; Course HMT 280; *Hazardous Materials Health Effects*

Also read: “Principles of Toxicology” in: *EPA Training Manual 165.5: Hazardous Materials Incident Response Operations*; available from ACGIH; catalog no: 3110; 6500 Glenway Ave.; Bldg. D-7; Cincinnati, OH 45211; (513) 661-7881

Also read: “Industrial Toxicology” (chap. 15) from: B. Plog; *Fundamentals of Industrial Hygiene*; National Safety Council; 3rd ed (1988); available from National Safety Council; Order Processing; 1815 Landmeier Road; Elk Grove Village, IL 60007-2420; (800) 621-7619 available from ACGIH; catalog no: 0670; 6500 Glenway Ave.; Bldg. D-7; Cincinnati, OH 45211; (513) 661-7881

See pp. 443 to 449; Section VIII in: M. Key, et. al; *Occupational Diseases; A Guide to Their Recognition*; U.S. Dept. of Health, Education, and Welfare; DHEW Pub. No. (NIOSH) 77-181; 1977

Also see Chaps. 4-10 in: P. Williams & J. Burson; *Industrial Toxicology; Safety and Health Applications in the Workplace*; Van Nostrand Reinhold, Pub.; New York; 1985

See Chaps. 8; “Carcinogenesis”; in: C. Kupchella; *Dimensions of Cancer*; Wadsworth Pub. Co; Belmont, CA.; 1987

Schedule and Assignment

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments are:

Lesson 2: Routes of Entry and Target Organs; pp. 2-21 to 2-92 of HMTRI; Course HMT 280; *Hazardous Materials Health Effects*

“Principles of Toxicology” in: *EPA Training Manual 165.5: Hazardous Materials Incident Response Operations*

Pages 443 to 449; Section VIII in: M. Key, et. al; *Occupational Diseases; A Guide to Their Recognition*

Survey of Common Toxic Substances

Intent and Purpose

This lesson provides students with the principal toxicity associated with those chemical groups most commonly released in the U.S. and in California. These include the corrosives (like sulfuric acid and ammonium hydroxide), metals (such as aluminum oxide), organic solvents (such as trichloroethane and toluene), other organic compounds (such as methanol, glycol ether, and acetone) and pesticides (such as the organophosphate insecticides).

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Identify** the most commonly released chemicals associated with human injury or death.
2. **Describe** the principal toxicity of chlorine.
3. **Describe** the principal toxicity of ammonia.
4. **Describe** the principal toxicity of corrosives.
5. **Describe** the principal toxicity of the following metals:
 - arsenic
 - mercury
 - cadmium
 - beryllium
 - chromium VI
 - lead
 - aluminum
6. **Describe** the principal toxicity of methane.
7. **Describe** the principal toxicity of gasoline.
8. **Describe** the principal toxicity of methylene chloride.
9. **Describe** the principal toxicity of trichloroethane.
10. **Describe** the principal toxicity of the freons.
11. **Describe** the principal toxicity of methanol.
12. **Describe** the principal toxicity of glycol ether.
13. **Describe** the principal toxicity of epoxy compounds.
14. **Describe** the principal toxicity of acetone.
15. **Describe** the principal toxicity of benzene, toluene & xylene.
16. **Describe** the principal toxicity of the polycyclic aromatic compounds.

17. *Describe* the principal toxicity of the organochlorine insecticides.

18. *Describe* the principal toxicity of organophosphate insecticides.

19. *Describe* the principal toxicity of carbamate insecticides.

Lesson Outline

1. The lesson is introduced by presenting a list of the most commonly released chemicals in the U.S and in California.

2. The principal toxicity of the following chemicals or chemical groups is presented:

- Chlorine
- Ammonia & ammonium compounds
- Corrosives
- Metals & metal compounds

3. The principal toxicity of the following solvents & other organic compounds is presented:

- The Aliphatic Hydrocarbons
- The Chlorinated Aliphatic Hydrocarbons
- The Aliphatic Alcohols
- The Glycols & Derivatives
- The Ethers & Epoxy Compounds
- The Aldehydes & Ketones
- The Aromatic Hydrocarbons
- Phenol & phenolic compounds
- Polycyclic aromatic compounds

4. The principal toxicity of Carbon Disulfide is presented.

5. The principal toxicity of Pesticides (biocides) is presented, including:

- algicides
- fungicides

- herbicides
- nematocides
- molluscides
- rodenticides
- organochlorine insecticides
- organophosphate insecticides
- carbamate insecticides
- rotenoid insecticides
- pyrethroid insecticides
- inorganic insecticides

Suggestions for Development and Presentation

The main purpose of this survey of toxic substances is to present a summary of the principal toxicity of those chemical most commonly associated with spills and releases in the U.S. in general, and California specifically. I would emphasize the major characteristics and not focus on all the minutiae.

References and Resources

See Lesson 3: Control Measures; pp. 3-70 to 3-94 of HMTRI; Course HMT 280; *Hazardous Materials Health Effects*; 1988

See Section VII in: M. Key, et. al; *Occupational Diseases; A Guide to Their Recognition*; U.S. Dept. of Health, Education, and Welfare; DHEW Pub. No. (NIOSH) 77-181; 1977

Also see Chaps. 18, 19, 20, 21, 25, & 26 in: C. Klaassen, et. al; Casarett & Doull's Toxicology: *The Basic Science of Poisons*; (3rd ed.); MacMillan Publishing Co.; New York; 1986

Also see Chapter 7 in: E. Hodgson & P. Levi; *A Textbook of Modern Toxicology*; Elsevier Science Publishing Co, Inc; New York; 1987

Also see Chaps. 5-9 in: R. Scott; *Chemical Hazards in the Workplace*; CRC-Lewis Publishers; 1989

Also see Chaps. 10, 11, & 12 in: P. Williams & J. Burson; *Industrial Toxicology; Safety and Health Applications in the Workplace*; Van NostrandReinhold, Pub.; New York; 1985

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments are:

Lesson 3: Control Measures; pp. 3-70 to 3-94 of HMTRI; Course HMT 280; *Hazardous Materials Health Effects*

Section VII in: M. Key, et. al; *Occupational Diseases; A Guide to Their Recognition*

Survey of Common Toxic Substances

Intent and Purpose

This lesson provides students with the principal toxicity associated with asbestos, radon, the criteria air pollutants, and the most common indoor air pollutants are identified and assessed. In addition, the principal sources of infectious wastes are considered.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Describe** the principal toxicity of asbestos.
2. **Describe** the principal toxicity of radon.
3. **Describe** the principal toxicity of the criteria air pollutants.
4. **Describe** the principal types of indoor air pollutants.
5. **Describe** the principal sources of infectious wastes.

Lesson Outline

The principal toxicity of the following materials is presented:

1. Asbestos (dust & fibers)
2. Radiation & Radioactive Materials, including:
 - radon
 - Radiation Protection Standards
3. Air Pollutants, including:
 - ambient pollutants

- indoor pollutants

4. Infectious Wastes, including:

- laboratory waste (incl: cultures)
- pathologic specimens (incl: tissues; blood; excreta; secretions)
- disposable fomites, disposable instruments, equipment; dialysis wastes; needles, etc.
- animal carcasses

Suggestions for Development and Presentation

The main purpose of this survey of toxic substances is to present a summary of the principal toxicity associated with asbestos, radon, the criteria air pollutants, the most common indoor air pollutants and the principal types of infectious wastes. I would emphasize the major characteristics and not focus on all the minutiae.

References and Resources

Also see Chaps. 18, 19, 20, 21, 25, & 26 in: C. Klaassen, et. al; Casarett & Doull's *Toxicology: The Basic Science of Poisons*; (3rd ed.); MacMillan Publishing Co.; New York; 1986

See Sections III, VIII & X in: M. Key, et. al; *Occupational Diseases; A Guide to Their Recognition*; U.S. Dept. of Health, Education, and Welfare; DHEW Pub. No. (NIOSH) 77-181; 1977

Also see Chapter 7 in: E. Hodgson & P. Levi; *A Textbook of Modern Toxicology*; Elsevier Science Publishing Co, Inc; New York; 1987

Also see Chaps. 5-9 in: R. Scott; *Chemical Hazards in the Workplace*; CRC-Lewis Publishers; 1989

Also see Chaps. 10, 11, & 12 in: P. Williams & J. Burson; *Industrial Toxicology; Safety and Health Applications in the Workplace*; Van NostrandReinhold, Pub.; New York; 1985

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments are:

Section III, VIII, & X in: M. Key, et. al; *Occupational Diseases; A Guide to Their Recognition*

Risk Assessment

Intent and Purpose

In this lesson the complex processes of risk assessment and risk management are introduced. As each of the four components of risk assessment are presented, various complicating factors and uncertainties are considered. The derivation of the Reference Dose (RfD) for non-carcinogenic (threshold) effects and the Cancer Potency Factor (q_1^*) for carcinogenic (non-threshold) effects is also presented. Also considered are the factors that affect the public's perception of a risk as being acceptable or not acceptable. Finally, the theoretical basis for "action levels" is considered.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Describe** 5 applications of the Risk Assessment methodology.
2. **Define** the following:
 - risk
 - de minimis risk
 - safe
 - Maximum Exposed Individual (MEI)
3. **Identify** and describe the four components of the risk assessment process.
4. **Identify** the five principal exposure pathways.
5. **Compute** the following:
 - The average daily intake of a substance for an adult given the concentration of a substance in drinking water
 - Normalize this average daily intake for body weight
6. **Explain** under what conditions it is appropriate to sum the doses each different exposure route and when it is not appropriate.
7. **Define** the following:
 - SNARL
 - Reference Dose (RfD)
 - Cancer Potency Factor (q_1^*)

- Action level

8. **Compute** the following:

- The Individual Lifetime Cancer Risk (ILCR) given a substance's average lifetime exposure and its cancer potency factor
- The Aggregate Lifetime Cancer Risk (ALCR) given the size of a population and given a substance's average lifetime exposure and its cancer potency factor
- The annual incidence of cancer in a population as a result of the exposure, given the size of a population and given the lifetime exposure and its cancer potency factor
- The risk of harm from a non-carcinogenic (threshold) effect given the RfD and the estimated daily human dose
- The carcinogenic (non-threshold) risk given the estimated daily dose and the cancer potency factor

9. **Distinguish** between risk assessment and risk management.

10. **Identify** and explain five factors that affect the public's perception of a risk.

11. **Compute** the Acceptable Daily Intake (ADI) given a substance's NOAEL and a safety factor of 100.

Lesson Outline

1. The lesson is introduced by considering the concept of Risk Assessment, including:

- The uses of Risk Assessment
- The definition of risk
- Expressing the risk qualitatively & quantitatively
- The definition of safety
- Acceptable ("de minimis") risk

2. The Hazard Identification component is presented, including:

- The purpose of Hazard Identification
- The elements of Hazard Identification

3. The Human Exposure Evaluation component is presented, including:

- The purpose of Human Exposure Evaluation
- The elements of Human Exposure Evaluation

- Distinguishing between exposure and dose absorbed

- Maximum Exposed Individual (MEI)

4. The Dose-Response Evaluation component is presented, including:

- The purpose of the Dose-Response Evaluation
- The elements of the Dose-Response Evaluation
- The Suggested No Adverse Response Level (SNARL)
- Computing the Reference Dose (RfD)
- Computing the Cancer Potency Factor (q_1^*)
- Computing the Individual Lifetime Cancer Risk (ILCR)
- Computing the Aggregate Lifetime Cancer Risk (ALCR)

5. The Risk (Characterization) Estimation component is presented, including:

- The purpose of the Risk (Characterization) Estimation
- The elements of the Risk (Characterization) Estimation
- Computing the Margin of Safety (MOS)
- Computing the Carcinogenic Risk

5. The concept of Risk Management is presented, including:

- The purpose of the Risk Management
- The factors affecting risk perception
- Acceptable Daily Intakes (ADI)
- Use of safety (uncertainty) factors
- The use of “action levels”

Suggestions for Development and Presentation

The mathematical nature of this material demands that the instructor be well prepared before presenting it. I would also strongly recommend that the students should be given some problems to solve after the lesson for practice. The ability to do the computations not only indicates a mastery over the arithmetic operations, but more importantly, it reflects conceptual understanding of the principles and derived values.

References and Resources

See Lesson 1: Risk Assessment; pp. 1-9 to 1-44 of HMTRI; Course HMT 280; *Hazardous Materials Health Effects*; 1988

Read EPA; *Principles of Risk Assessment; A Nontechnical Review*

Also see Chap. 17 in: P. Williams & J. Burson; *Industrial Toxicology; Safety and Health Applications in the Workplace*; Van Nostrand Reinhold, Pub.; New York; 1985

See AAAS: Science; April 17, 1987; 236: 267-300

See American Chemical Society; Chemical Risk Communication; 1988; available from: ACS; Department of Government Relations & Science Policy; 1155 Sixteenth Street, NW; Washington, DC 20036; (202) 872-4395

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction. Student reading/study assignments are:

Lesson 1: Risk Assessment; pp. 1-9 to 1-44 of HMTRI; Course HMT 280; *Hazardous Materials Health Effects*

Students should have the EPA; *Principles of Risk Assessment; A Nontechnical Review* to read

Clinical Symptoms and Treatment of Toxicity

Intent and Purpose

In this lesson the basic principles of medical diagnosis and initial response to toxicity is presented.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Describe** the signs and symptoms of chemical exposure.
2. **Describe** the order for treating symptoms.
3. **Describe** the treatment for chemical inhalation.
4. **Describe** the treatment for chemical ingestion.
5. **Describe** the treatment for chemical contact on the skin.
6. **Describe** the treatment for chemical contact in the eyes.

Lesson Outline

1. The lesson is introduced by considering the signs and symptoms of chemical exposure, including:

- irritation of eyes,nose,skin or throat
- light-headedness or dizziness
- headache
- coughing or sneezing
- tightness in chest or breathing difficulties
- weakness or decrease in coordination
- sweating
- changes in skin color
- tearing
- nausea
- cramps & diarrhea
- irritability or behavioral changes

2. The order for treating symptoms is presented:

- Cessation of Breathing
- Eye Injury
- Skin Contact
- Shock

3. The treatment for chemical inhalation is presented, including:

- Remove him from the contaminated area
- Lay him down with his Legs Raised
- Loosen his collar & belt
- Cover him with a blanket
- Calm & Reassure him

4. The treatment for chemical ingestion is presented, including:

- Remove him from the contaminated area
- Make him rinse his mouth with cold water
- Loosen his collar & belt
- Lay him down with his Legs Raised
- Cover him with a blanket
- Minimize his moving & speaking

5. The treatment for chemical contact on the skin is presented, including:

- Take him immediately to the nearest shower
- Remove clothing from the affected areas
- Wipe off any excess chemical very gently
- Wash affected area under the shower with soap
- Rinse affected area with lukewarm water
- Dry the skin gently with soft towel

6. The treatment for chemical contact in the eyes is presented, including:

- Take him immediately to the nearest shower
- Wipe off any excess chemical very gently
- With eyelids held open, wash eyes under slowly running water for at least 15 minutes

Suggestions for Development and Presentation

This lesson would lend itself to inviting an occupational health nurse, occupational health physician, or public health officer to speak to the class.

References and Resources

Marc J. Lefevre; *First Aid Manual for Chemical Accidents*; ISBN0-442-20490-6; Van Nostrand Reinhold Co; New York; 1980; (800) 926-2665

Schedule and Assignment

This lesson is suggested to take 3 hours of classroom instruction.

Sources of Information on Toxic Substances & Industrial Hygiene

Intent and Purpose

This lesson is intended to provide students with: (1) the sources and types of information available dealing with the health effects of hazardous materials; and (2) the professional organizations and career opportunities related to public health and safety, environmental health, and industrial hygiene.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Identify** the following:

- HESIS
- EPA
- OHEA
- NIOSH
- RTECS
- ACGIH
- AIHA
- ABIH
- CA DHS RCHAS
- CA DHS TSCD

2. **Identify** the four facets to the practice of Industrial Hygiene.

3. **Describe** the role of a Certified Safety Professional

Lesson Outline

Sources of Technical Information on Toxic Substances:

Hazard Evaluation System & Information (HESIS)
California Occupational Health Program
2151 Berkeley Way

Berkeley, CA 94704

(415) 540-3014

(800) 233-3360

Environmental Protection Agency (EPA)

Office of Health & Environmental Assessment (OHEA)

(RD-689)

401 M Street; SW

Room 3703

Washington, DC 20460

(202) 382-7345

Environmental Protection Agency (EPA)

Center for Environmental Research Information (CERI)

Office of Research and Development

26 West Martin Luther King Drive

Cincinnati, OH 45268

(513) 569-7562

National Institute for Occupational Safety & Health (NIOSH)

Information Dissemination, C-13

4676 Columbia Parkway

Cincinnati, OH 45226-1998

(513) 533-8287

NIOSH Registry of Toxic Effects of Chemical Substances (RTECS) available from:

U.S. Government Printing Office

Superintendent of Documents

Washington, DC 20402-9325

(202) 783-3238

(213) 894-5841

Poison Centers

Northridge Tox-Center

(818) 885-9888 — for emergencies

(818) 885-8500 — for information

UC-Irvine Poison Control Center

(714) 634-5988

UC-San Diego Poison Control Center

(619) 294-6000

UC-Davis Poison Control Center

(916) 453-3692

(800) 852-7221

Environmental Technology

UC-San Francisco Poison Control Center
(415) 476-6600
(800) 233-3360

Other References

American Conference of Governmental Industrial Hygienists (ACGIH)
6500 Glenway Ave., Bldg. D-5
Cincinnati, OH 45211-4438
(513) 661-7881

American Industrial Hygiene Association (AIHA)
P.O. Box 8390
345 White Pond Drive
Akron, OH 44320
(216) 873-2442

American National Standards Institute, INC. (ANSI)
1430 Broadway
New York, NY 10018
(212) 354-3300

Association of American Railroads
Bureau of Explosives
50 F St; NW
Washington, DC 20001
(202) 639-2100

California Air Resources Board (CARB)
Stationary Sources Division
Toxic Air Contaminant Identification Branch
(916) 322-7072

California Dept. of Health Services
Reproductive & Cancer Hazard Assessment Section (RCHAS)
2151 Berkeley Way, Annex 2
Berkeley, CA 94704
(415) 540-2084

California Dept. of Health Services
Toxic Substances Control Division (TSCD)
Public Information
714 P St.
Sacramento, CA 95814
(916) 323-9219

CAL-OSHA

California Dept. of Industrial Services
Right-to-Know Unit
(415) 540-3037
(213) 861-9993

Chemical Industry Council of California
(916) 442-1420

Chemical Manufacturers Association
2501 M St; NW
Washington, DC 20037
(202) 887-1150

Environmental Affairs Agency
Office of Hazardous Materials, Data Management
P.O. Box 2815
Sacramento, CA 95812
(916) 327-1848

Environmental Protection Agency (EPA)
Region IX
(415) 974-8131

Environmental Protection Agency (EPA)
Forms & Publications Distribution Center
Cincinnati, OH
(513) 569-7562

Federal Emergency Management Agency (FEMA)
Region IX
Bldg. 105
Presidio of San Francisco
San Francisco, CA 94129
(415) 923-7187

National Fire Protection Association (NFPA)
1 Batterymarch Park
P.O. Box 9101
Quincy, MA 02169
(800) 344-3555

National Safety Council (NSC)
West Coast Head Office
1111 Triton Drive, Suite 201
Foster City, CA 94404-1217
(800) 848-5588
(213) 385-6461

Environmental Technology

National Technical Information Service (NTIS)

US Dept. of Commerce
5285 Port Royal Road
Springfield, VA 22161
(703) 557-4434
(703) 487-4780

Nuclear Regulatory Commission (NRC)

1717 H St, NW
Washington, DC 20555
(202) 492-7000

Occupational Safety & Health Administration (OSHA)

Southern California Regional Office
7807 Convoy Court, Suite 160
San Diego, CA 92111
(619) 569-9071
(800) 648-1003

South Coast Air Quality Management District

Air Toxics Control Branch
Hazardous Materials Section
9150 Flair Drive
El Monte, CA 91731
(818) 571-5104

State Water Resources Control Board

Public Affairs
(916) 322-8353

US Dept. of Health & Human Resources (DHHS)

Agency for Toxic Substances & Disease Registry
Chamblee Bldg; 30-S
Atlanta, GA 30333
(404) 452-4100

US Dept. of Transportation

Research & Special Programs Administration
Office of Hazardous Materials Transportation
DHM-11
400 Seventh Street; SW
Washington, DC 20590
(800) 752-6367
(202) 366-4488

U.S. Government Printing Office (GPO)

Superintendent of Documents
Washington, DC 20402-9325
(202) 783-3238
(213) 894-5841

Information on Industrial Hygiene

- Definition of Industrial Hygiene
- Becoming an Industrial Hygienist
- Professional Organizations
 - American Industrial Hygiene Association (AIHA)
 - American Academy of Industrial Hygiene (AAIH)

Information on the Certified Safety Professional (CSP)

Definition of a Safety Professional

References and Resources

Also read: “Appendix A; Sources of Help”, pp. 727-765 from: B. Plog; *Fundamentals of Industrial Hygiene*; National Safety Council; 3rd ed (1988); available from National Safety Council; Order Processing; 1815 Landmeier Road; Elk Grove Village, IL 60007-2420; (800) 621-7619 available from ACGIH; catalog no: 0670; 6500 Glenway Ave.; Bldg. D-7; Cincinnati, OH 45211; (513) 661-7881

Basics of Industrial Hygiene

Instructor's Guide

Prepared By:

Steven Fink
Director of the EHMT Program
West Los Angeles College
4800 Freshman Drive
Culver City, CA 90230
(213)836-7110, ext. 237

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Preface

This is the instructor's guide for a module entitled *Basics of Industrial Hygiene*.

This module is part of *Health Effects of Hazardous Materials*, a 3 unit lecture core course in the EHMT Associate Degree and Certificate Program. The course is designed to provide students with instruction in principles of toxicology and industrial hygiene.

The course has been divided into three modules:

- Module I Basics of Toxicology (2 units)
- Module II Basics of Industrial Hygiene (1 unit)

This modularization has been designed in such a way that the course can be taught as two separate courses. Module I is 36 hours and therefore represents 2 units. Module II is 18 hours and therefore represents 1 unit.

Modularization will allow the maximum flexibility for individual colleges to meet both traditional educational goals **and** the immediate needs of local industry. This flexibility is evidenced by the following available options, since the modules can be used in whole or part for:

- Contract Education
- Community Service Classes
- Degree and Certificate Applicability

Note to Instructors: It is suggested that the instructor using this guide become entirely familiar with the lesson plan and student materials prior to starting the course. Changes should be made as needed to reflect current regulations.

Basics of Industrial Hygiene

Module Description

This module presents the basics of industrial hygiene as it applies to hazardous materials. Topics include a discussion on the types of environmental health hazards, exposure limit standards, the use of air monitoring instruments, exposure control methods, personal protective equipment, medical surveillance of toxic substances, and the use of MSDS's. Sources of information on toxic substances and industrial hygiene are also presented.

The competencies fulfilled by this course are:

- I. Hazardous Materials Handling and Sampling
 - A. Handles hazardous materials/wastes
 - 1. Identifies, selects, and recommends safety equipment
- II. Procedures and Plans for Regulatory Compliance
 - A. Assists in development of organizational goals and prevention plans with relation to hazardous materials/wastes and safety
 - B. Tracks regulatory compliance
 - 1. Procures current MSDS's
 - 2. Understands and utilizes information on MSDS's

Specific objectives are listed for each of the 12 lessons described in this module.

Texts

Suggested Student Text:

Excerpts from the various sources described in the lessons.

Instructor Resources and References are described within this document as well.

Instructor Note

Note to Instructors: It is suggested that the instructor using this module read through **all** lessons prior to starting the course. In this way, later concepts which are built on earlier activities can be better anticipated and planned for.

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** Supplemental Instructor & Student Materials can be obtained through the Anaheim Higher Education Center. Order form is located in Appendix D.*

1. Types of Environmental Health Hazards

Intent and Purpose

By definition, “hazardous materials” pose a “hazard”. In this lesson, the student will learn the definition of a “hazard” and be asked to consider all the different types of hazards that might exist routinely in the workplace or occur in the event of an emergency. Students should also be asked to suggest specific examples for each hazard category. The student will also be briefly introduced to the US DOT and NFPA “Hazard Diamond” classification systems. This will provide an immediate practical connection to hazard analysis and classification. The principal goal of this lesson is for the student to develop the vocabulary to understand a hazard analysis.

This lesson also provides students with: (1) the sources and types of information available dealing with the health effects of hazardous materials; and (2) the professional organizations and career opportunities related to public health and safety, environmental health, and industrial hygiene.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. *Define* “hazard.”
2. *Distinguish* between “chemical”, “physical”, and “biological” hazards, and give examples of each.
3. *Distinguish* between a “gas”, a “vapor”, a “mist”, and a “fume.”
4. *Distinguish* between “ionizing radiation” and “non-ionizing” radiation.
5. *Distinguish* between “bacteria” and “viruses.”
6. *Identify* four common occasions of hazardous material exposure.
7. *Identify* the four components of the NFPA Hazard Diamond.
8. *Explain* the NFPA numbering system (from 1 to 4).
9. *Identify* what an “etiologic agent” is.
10. *Differentiate* between a “flammable” and “combustible” material (according to the DOT).
11. *Identify* the following:
 - HESIS
 - EPA
 - OHEA
 - NIOSH
 - RTECS
 - ACGIH
 - AIHA
 - ABIH
 - CA DHS RCHAS
 - CA DHS TSCD

12. **Identify** the four facets to the practice of Industrial Hygiene.

13. **Describe** the role of a Certified Safety Professional.

Lesson Outline

1. The lesson is introduced with a definition of “a hazard.”
2. The different types of hazards that might exist routinely in the workplace or occur in the event of an emergency are reviewed.

3. The types of Chemical Hazards are differentiated based on their physical state(s), including:

- solids
- liquids
- gases
- vapors
- dusts
- fumes
- fibers
- mists
- mixtures

4. The types of Physical Hazards are considered, including:

- Fire and Explosion due to ignition, chemical reactions, sudden release of a pressurized gas, etc.
- Oxygen deficiency
- Noise
- Temperature extremes, including heat stress and cold exposure
- Radiation, including both ionizing and non-ionizing
- Electrical hazards
- Safety hazards such as slippery surfaces and sharp or heavy objects, etc.

5. The types of Biological Hazards are considered, including:

- bacteria
- viruses
- fungi
- poison ivy & oak

6. Common occasions of hazard exposure to chemical substances, including:

- Points of hazardous material measurement or sampling.
- Transfer points for hazardous materials.
- Packaging & unpackaging of hazardous materials.
- Process Operations involving hazardous materials, like welding, machining, plating, spray coating, using cleaning solvents, etc.
- Maintenance activities at sites of hazardous materials.
- Process upsets and releases.

7. The student is introduced to commonly used Hazard Classification Systems to see the practical application of hazard identification.
8. The U.S. DOT Hazard Class System is briefly presented, by defining and giving examples of a:
 - flammable liquid
 - combustible liquid
 - poison
 - etiologic agents
 - corrosive material
9. The NFPA Hazard Ranking System is presented and examples are used to explain the:
 - Health Hazard Potential (Blue)
 - Fire Hazard Potential (Red)
 - Reactivity Hazard Potential (Yellow)
 - Special Hazard Potential (White)
10. The scope of industrial hygiene is considered, including:
 - Anticipation of hazards
 - Recognition of hazards
 - Evaluation of hazards
 - Control of hazards
11. Sources of Technical Information on Toxic Substances:

Hazard Evaluation System & Information (HESIS)
California Occupational Health Program
2151 Berkeley Way
Berkeley, CA 94704
(415) 540-3014
(800) 233-3360

Environmental Protection Agency (EPA)
Office of Health & Environmental Assessment (OHEA)
(RD-689)
401 M Street; SW
Room 3703
Washington, DC 20460
(202) 382-7345

Environmental Protection Agency (EPA)
Center for Environmental Research Information (CERI)
Office of Research and Development
26 West Martin Luther King Drive
Cincinnati, OH 45268
(513) 569-7562

Environmental Technology

National Institute for Occupational Safety & Health (NIOSH)
Information Dissemination, C-13
4676 Columbia Parkway
Cincinnati, OH 45226-1998
(513) 533-8287

NIOSH Registry of Toxic Effects of Chemical Substances (RTECS) available from:
U.S. Government Printing Office
Superintendent of Documents
Washington, DC 20402-9325
(202) 783-3238
(213) 894-5841
Poison Centers

Northridge Tox-Center
(818) 885-9888 — for emergencies
(818) 885-8500 — for information

UC-Irvine Poison Control Center
(714) 634-5988

UC-San Diego Poison Control Center
(619) 294-6000

UC-Davis Poison Control Center
(916) 453-3692
(800) 852-7221

UC-San Francisco Poison Control Center
(415) 476-6600
(800) 233-3360

Other References

American Conference of Governmental Industrial Hygienists (ACGIH)
6500 Glenway Ave., Bldg. D-5
Cincinnati, OH 45211-4438
(513) 661-7881

American Industrial Hygiene Association (AIHA)
P.O. Box 8390
345 White Pond Drive
Akron, OH 44320
(216) 873-2442

American National Standards Institute, INC. (ANSI)
1430 Broadway
New York, NY 10018
(212) 354-3300

Environmental Technology

Association of American Railroads
Bureau of Explosives
50 F St; NW
Washington, DC 20001
(202) 639-2100

California Air Resources Board (CARB)
Stationary Sources Division
Toxic Air Contaminant Identification Branch
(916) 322-7072

California Dept. of Health Services
Reproductive & Cancer Hazard Assessment Section (RCHAS)
2151 Berkeley Way, Annex 2
Berkeley, CA 94704
(415) 540-2084
California Dept. of Health Services

Toxic Substances Control Division (TSCD)
Public Information
714 P St.
Sacramento, CA 95814
(916) 323-9219

CAL-OSHA
California Dept. of Industrial Services
Right-to-Know Unit
(415) 540-3037
(213) 861-9993

Chemical Industry Council of California
(916) 442-1420

Chemical Manufacturers Association
2501 M St; NW
Washington, DC 20037
(202) 887-1150

Environmental Affairs Agency
Office of Hazardous Materials, Data Management
P.O. Box 2815
Sacramento, CA 95812
(916) 327-1848

Environmental Protection Agency (EPA)
Region IX
(415) 974-8131

Environmental Technology

Environmental Protection Agency (EPA)
Forms & Publications Distribution Center
Cincinnati, OH
(513) 569-7562

Federal Emergency Management Agency (FEMA)
Region IX
Bldg. 105
Presidio of San Francisco
San Francisco, CA 94129
(415) 923-7187

National Fire Protection Association (NFPA)
1 Batterymarch Park
P.O. Box 9101
Quincy, MA 02169
(800) 344-3555

National Safety Council (NSC)
West Coast Head Office
1111 Triton Drive, Suite 201
Foster City, CA 94404-1217
(800) 848-5588
(213) 385-6461
National Technical Information Service (NTIS)
US Dept. of Commerce
5285 Port Royal Road
Springfield, VA 22161
(703) 557-4434
(703) 487-4780

Nuclear Regulatory Commission (NRC)
1717 H St, NW
Washington, DC 20555
(202) 492-7000

Occupational Safety & Health Administration (OSHA)
Southern California Regional Office
7807 Convoy Court, Suite 160
San Diego, CA 92111
(619) 569-9071
(800) 648-1003

South Coast Air Quality Management District
Air Toxics Control Branch
Hazardous Materials Section
9150 Flair Drive
El Monte, CA 91731
(818) 571-5104

State Water Resources Control Board
Public Affairs
(916) 322-8353

US Dept. of Health & Human Resources (DHHS)
Agency for Toxic Substances & Disease Registry
Chamblee Bldg; 30-S
Atlanta, GA 30333
(404) 452-4100

US Dept. of Transportation
Research & Special Programs Administration
Office of Hazardous Materials Transportation
DHM-11
400 Seventh Street; SW
Washington, DC 20590
(800) 752-6367
(202) 366-4488

U.S. Government Printing Office (GPO)
Superintendent of Documents
Washington, DC 20402-9325
(202) 783-3238
(213) 894-5841

12. Information on Industrial Hygiene

- Definition of Industrial Hygiene
- Becoming an Industrial Hygienist
- Professional Organizations
- American Industrial Hygiene Association (AIHA)
- American Academy of Industrial Hygiene (AAIH)

13. Information on the Certified Safety Professional (CSP)

- Definition of a Safety Professional

Suggestions for Development and Presentation

It is important to emphasize the different physical states of chemical hazards since this has great bearing on the route(s) of entry into the human, and thus their potential harm to health (toxicity). Special attention should be paid to clearly differentiating between a gas, a vapor, a mist, and a fume.

A source of confusion is the inconsistent use of the terms “hazard”, “hazardous material”, and “toxic substance”. I would suggest the following:

A *hazard* is anything having the capacity to cause physical damage (ex: cause a fire to a building) or harm the health of living organisms.

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A *hazardous material* refers to any chemical substance or agent (ex: a microorganism) that poses a physical and/or health hazard.

Those chemical substances or agents (hazardous materials) that have the potential to harm the health of living organisms are called *toxic substances*. Toxic substances are thus a subset of hazardous materials.

Presentation of the DOT and NFPA Hazard Classification Systems at this time is not intended to be in depth. Some students may already be knowledgeable with one or both of these systems, but all students will have some recognition of the NFPA Hazard Diamond and the DOT hazard placards. The purpose here is to connect the technical vocabulary with the “real world”.

References and Resources

Hazard Analysis:

- See pp. 2-13 & 2-14 of HMTRI; Course HMT 280; *Hazardous Materials Health Effects*, 1988
- Read “Hazards”, chap. 2 from: NIOSH/OSHA/USCG/EPA; *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*; DHHS (NIOSH) Pub. No. 85-115; Oct. 1985; GPO No. 017-033-00426-9; available from: Superintendent of Documents; Government Printing Office; Washington D.C. 20402-9325; (202) 783-3238
- Also read: *Materials and Their Characteristics*, Chap. 2 from: L.V. Cralley & L.J. Cralley; *In-Plant Practices for Job Related Health Hazards Control*; Vol. 2: *Engineering Aspects*; John Wiley & Sons; 1989; (800) 225-5945
- Also read: “Overview of Industrial Hygiene,” pp. 6-17 (chap. 1) from: B. Plog; *Fundamentals of Industrial Hygiene*; National Safety Council; 3rd ed (1988); available from National Safety Council; Order Processing; 1815 Landmeier Road; Elk Grove Village, IL 60007-2420; (800) 621-7619 or available from ACGIH; catalog no: 0670; 6500 Glenway Ave.; Bldg. D-7; Cincinnati, OH 45211; (513) 661-7881

Hazard Classification Systems:

- See “Hazardous Materials Classification Systems”, chap. 8 from the FEMA/US DOT/US EPA *Handbook of Chemical Hazard Analysis Procedures*; 1989; (301) 447-1068
- NFPA; *Fire Protection Guide on Hazardous Materials*; 9th ed. (1989); National Fire Protection Association (NFPA); 1 Batterymarch Park; P.O. Box 9101; Quincy, MA 02169; (800) 344-3555

Sources of Technical Information on Toxic Substances:

Also read: “Appendix A; Sources of Help”, pp. 727-765 from: B. Plog; *Fundamentals of Industrial Hygiene*; National Safety Council; 3rd ed. (1988); available from National Safety Council; Order Processing; 1815 Landmeier Road; Elk Grove Village, IL 60007-2420; (800) 621-7619
available from ACGIH; catalog no: 0670; 6500 Glenway Ave.; Bldg. D-7; Cincinnati, OH 45211; (513) 661-7881

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments are:

- “Hazards”(Chap 2) from: NIOSH/OSHA/USCG/EPA; *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*

- “Hazardous Materials Classification Systems (chap. 8) from: FEMA/US DOT/US EPA, *Handbook of Chemical Hazard Analysis Procedures*

2. Exposure Limits

Intent and Purpose

In this lesson, the student is introduced to how the principles of toxicology are applied to the real world; to the workplace, to the air, and to the drinking water. Exposure limits have been adopted by a number of different groups to protect against harm from short-term and long-term exposures. The student is introduced to the types of exposure limits, the units for expressing the exposure limits, and how to calculate exposure limits for mixtures. The limitations to using these exposure limits is also considered.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Compare** who the workplace exposure limits were developed for versus the air and water pollutant exposure limits.
2. **Describe** the following terms associated with workplace exposure limits:
 - OSHA
 - CAL-OSHA
 - PELs
 - NIOSH
 - RELs
 - ACGIH
 - TLVs
 - AIHA
 - WEELs
3. **Identify** for which exposure route most of the workplace limits were designated, and why.
4. **Convert** between ppm and mg/m³
5. **Describe** the differences between each of the following types of exposure limits:
 - TWA
 - STEL
 - Ceiling
6. **Explain** how it is possible for a worker to be harmed from a toxic exposure, even when the TWA limit has not been exceeded.
7. **Describe** (1) what an IDLH condition is, and (2) explain what a worker is permitted to do under an IDLH condition.
8. **Calculate** the total combined exposure for mixtures of toxic substances with additive effects on the same target organ.

9. **Describe** the Delaney Amendment of the Food, Drugs, & Cosmetics Act.

10. **Describe** four limitations in using the workplace exposure limits.

11. **Describe** the following terms associated with air pollution exposure limits:

- AAQS
- EPA
- DHS
- CARB

12. **Describe** the following terms associated with water pollution exposure limits:

- MCLs
- EPA
- DHS
- SWQCB

Lesson Outline

1. The lesson is introduced by considering the purpose of setting exposure limits to toxic substances, and including the basis for how they are set.
2. The different sources of workplace exposure standards & guidelines are considered, including:

- OSHA
- NIOSH
- ACGIH
- AIHA

3. The units for expressing the exposure limit concentrations, and how to perform unit conversions, are presented including:

- ppm (mg/L)
- mg/m³
- mg/m³

4. The types of exposure limits for the workplace are described, including the:

- Time-Weighted Average (TWA)
- Short-Term Exposure Limit (STEL)
- Ceiling Values (C)
- “Skin” Exposures Immediately Dangerous to Life or Health (IDLH) conditions

5. The computation of the total combined exposure from a combination of additive exposures is presented.

6. The problem of exposure limits for carcinogens is considered The limitations to using the workplace exposure limits are considered.

7. The ambient air pollution exposure limits (NAAQS) are considered, including:

- The sources of air pollution exposure standards
- The units for expressing the exposure limit concentrations

8. The drinking water contaminant standards (MCLs) are considered, including:

- The sources of drinking water contaminant standards
- The units for expressing the contaminant level concentrations

Suggestions for Development and Presentation

The student should actually be shown how to read and utilize (1) the OSHA “Permissible Exposure Limits” listed in 29 CFR 1910.1000, Subpart Z, (2) the NIOSH Pocket Guide to Chemical Hazards, and (3) the ACGIH Threshold Limit Values and Biological Exposure Indices. An exercise in looking-up the exposure limits, understanding the various footnotes, and using the appendices will make these tools “user-friendly” to the student.

The student should also have a copy of the NAAQS and the MCLs for drinking water to appreciate how these also serve as exposure limits (indeed, legally enforceable ones at that). Furthermore, the types of toxic substances that are of a health concern can be examined.

A useful exercise would be to ask students to compare the exposure limits for the workplace, the air, and the water for a single substance. For example, inorganic lead (Pb) has a workplace PEL-TWA of 50 mg/m³ (8 CCR Sec. 5155); a NAAQS of 1.5mg/m³; and a drinking water MCL of 50 mg/L. Note the difference between the Pb standard for the workplace, and the significantly lower standard for ambient air. Ask the student to explain the reasons for such a significant difference. (Consider the following: 8 hr exposure per day for 40 years versus 24 hr exposure per day for 70 years; healthy working age people versus infants, elderly, and ill people in the general population.)

References and Resources

See pp. 1-34 to 1-37 and pp. 3-15 to 3-20 of HMTRI; Course HMT 280; *Hazardous Materials Health Effects*; 1988

Read “Exposure Guidelines” in: *EPA Training Manual 165.5: Hazardous Materials Incident Response Operations*; available from ACGIH; catalog no: 3110; 6500 Glenway Ave.; Bldg. D-7; Cincinnati, OH 45211; (513) 661-7881

Also read: pp. 3-10 and pp. 46-50 in: *Threshold Limit Values and Biological Exposure Indices* (latest edition); ACGIH; catalog no: 0670; 6500 Glenway Ave.; Bldg. D-7; Cincinnati, OH 45211; (513) 661-7881

NIOSH; *Pocket Guide to Chemical Hazards* (NIOSH Pub. No: 85-114); latest edition; available from the U.S. Government Printing Office

See “Toxicity Hazards of Chemical Substances”, chap. 6 from the FEMA/US DOT/US EPA *Handbook of Chemical Hazard Analysis Procedures*; 1989; (301) 447-1068

Also read: “Industrial Toxicology” (chap. 15) & Appendix B-1 (pp. 769-785) from: B. Plog; *Fundamentals of Industrial Hygiene*; National Safety Council; 3rd ed (1988); available from National Safety Council; Order Processing; 1815 Landmeier Road; Elk Grove Village, IL 60007-2420; (800) 621-7619 available from ACGIH; catalog no: 0670; 6500 Glenway Ave.; Bldg. D-7; Cincinnati, OH 45211; (513) 661-7881

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction

Student reading/study assignments are:

Pages 1-34 to 1-37 and pp. 3-15 to 3-20 of HMTRI; Course HMT 280; *Hazardous Materials Health Effects*

“Exposure Guidelines” in: EPA Training Manual 165.5: *Hazardous Materials Incident Response Operations*

Pages 3-10 and pp. 46-50 in: *Threshold Limit Values and Biological Exposure Indices* (latest edition)

NIOSH; *Pocket Guide to Chemical Hazards* (latest edition)

3. Monitoring of Toxic Substances

Intent and Purpose

The intent of this lesson is to describe the various types of air monitoring instruments that are commonly used. The student will learn the advantages and disadvantages of the different air monitoring devices, and if the instruments are available, see their use demonstrated.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Explain** the principal uses of air monitoring for toxic contaminants.
2. **List** the limitations of relying on sensory awareness for monitoring the presence of toxic substances.
3. **Describe** the advantages & disadvantages of using Indirect Air Monitoring Instruments, including:
 - Low-flow air sampling pumps
 - High-flow air sampling pumps
 - Passive dosimeter badges
 - Radiation film badges
4. **Describe** the advantages & disadvantages of using Direct-Reading Air Monitoring Instruments, including:
 - Indicator tubes
 - Indicator badges
 - Oxygen monitors
 - Combustible Gas Indicator (CGI; explosimeters)
 - Hydrocarbon Detector (PID; HNU)
 - Radiation meters (Geiger-Mueller Counter)

Lesson Outline

1. The lesson is introduced by considering the uses of air monitoring, including:
 - to determine the identify of any air contaminants present

- to measure the air contaminant exposure levels to ascertain whether the level exceeds a regulatory standard
 - to locate sources of air contaminants
 - to determine where additional protection measures are necessary and to what substances specifically
2. The types of sensory awareness to toxic substances are described, and the limitations in relying on them are considered, including:
 - lack of sensitivity
 - variations in sensitivity
 - detectable concentration may be at a higher level than the toxic concentration
 3. The advantages & disadvantages of the different types of Indirect Air Monitoring Instruments is reviewed, including:
 - Low-flow air sampling pumps
 - High-flow air sampling pumps
 - Passive dosimeter badges
 - Radiation film badges
 4. The advantages & disadvantages of the different types of Direct-Reading Air Monitoring Instruments, including:
 - Indicator tubes
 - Indicator badges
 - Oxygen monitors
 - Combustible Gas Indicator (CGI; explosimeters)
 - Hydrocarbon Detector (HNU)
 - Radiation meters (Geiger-Mueller Counter)

Suggestions for Development and Presentation

It would be very informative to have the different types of air monitoring instruments available to show to the students.

Depending upon the time available, use of the instruments could even be demonstrated.

References and Resources

Read “Air Monitoring”, chap. 7 from: NIOSH/OSHA/USCG/EPA; *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*; DHHS (NIOSH) Pub. No. 85-115; Oct. 1985; GPO No. 017-033-00426-9; available from: Superintendent of Documents; Government Printing Office; Washington D.C. 20402-9325; (202) 783-3238

Also read: c-10 “Ionizing Radiation”; c-18 “Air Sampling Instruments”; and c-19 “Direct-Reading Gas & Vapor Monitors” from: B. Plog; *Fundamentals of Industrial Hygiene*; National Safety Council; 3rd ed (1988); available from National Safety Council; Order Processing; 1815 Landmeier Road; Elk Grove Village, IL 60007-2420; (800) 621-7619 available from ACGIH; catalog no: 0670; 6500 Glenway Ave.; Bldg. D-7; Cincinnati, OH 45211; (513) 661-7881

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments are:

“Air Monitoring” (chap. 7) from: NIOSH/OSHA/USCG/EPA; *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*

4. Exposure Control Methods

Intent and Purpose

In this lesson the principal control technologies that are utilized in the industrial setting to reduce worker exposure to hazardous materials will be presented. The student will be introduced to the different types of engineering controls, the principles and types of ventilation control, and examples of administrative (work practice) controls. The purpose of all of these methods is to reduce the worker’s exposure to those substances that are already known to be health hazards.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Rank** the methods for controlling exposures to toxic substances in order of their preference of use, and explain why.
2. **Describe** and give an example for each of the following types of engineering controls:
 - change in plant design
 - substitution
 - process change
 - isolation
3. **Describe** the relationship between the size of the contaminant and the capture velocity required for its removal.
4. **Compare** Local Exhaust Ventilation with General (dilution) Ventilation with respect to:
 - the components of the ventilation system
 - the principal limitations
 - the differences in the volume of replacement air required
 - the typical uses for each
5. **Describe** the differences between a centrifugal fan system and an axial-flow (“tube”) fan system, including the typical uses for each type.
6. **Describe** each of the following types of air-cleaning devices and indicate their typical uses:
 - fabric filters
 - electrostatic precipitators

- air scrubbers
 - carbon adsorbers
7. **List** four examples of administrative controls for reducing exposure to toxic substances and describe their limitations.
 8. **Describe** what information on a MSDS would be useful in helping to control a worker's exposure to toxic substances.

Lesson Outline

1. The lesson is introduced by considering the purpose of exposure control methods, including:
 - the settings where control is possible
 - the principal types of control methods
 - the order of preference in selecting the control methods
2. The different types of engineering controls are considered, including the advantages and disadvantages in:
 - changes in plant design & equipment selection
 - substitution of materials
 - process changes
 - equipment enclosure (isolation)
3. An introduction to local exhaust ventilation is presented, including:
 - the components of the ventilation system
 - the basic principals of operation
 - the principal advantages
 - the primary limitations
 - design factors
 - centrifugal ("curved") versus axial-flow ("tube") fans
4. An introduction to general (dilution) ventilation is presented, including:
 - the components of the ventilation system
 - the basic principals of operation
 - the principal advantages
 - the principal disadvantages
 - design factors
5. The principal types of air-cleaning devices and their uses is presented, including:
 - fabric filters
 - electrostatic precipitators
 - air scrubbers
 - carbon adsorbers

6. Types of administrative (work practice) controls are considered, including the benefits and limitations of:

- employee training
- work scheduling
- equipment maintenance
- employee selection & placement
- monitoring for contaminants
- recordkeeping

Suggestions for Development and Presentation

The instructor should be prepared with several specific examples for each of the various categories of control methods. The instructor should also encourage students to suggest specific examples.

References and Resources

See Lesson 3: Control Measures; pp. 3-8 to 3-14 and pp. 3-66 to 3-70 of HMTRI; Course HMT 280; *Hazardous Materials Health Effects*; 1988

Also see c-20 “Methods of Control”; c-21 “Industrial Ventilation”; and c-22 “General Ventilation” in: B. Plog; *Fundamentals of Industrial Hygiene*; National Safety Council; 3rd ed (1988); available from National Safety Council; Order Processing; 1815 Landmeier Road; Elk Grove Village, IL 60007-2420; (800) 621-7619 available from ACGIH; catalog no: 0670; 6500 Glenway Ave.; Bldg. D-7; Cincinnati, OH 45211; (513) 661-7881

Also read: “Building General Ventilation”, Chap. 7 from: L.V. Cralley & L.J. Cralley; *In-Plant Practices for Job Related Health Hazards Control*; vol 2: Engineering Aspects; John Wiley & Sons; 1989; (800) 225-5945

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments are:

Lesson 3: Control Measures; pp. 3-8 to 3-14 and pp. 3-66 to 3-70 of HMTRI; Course HMT 280; *Hazardous Materials Health Effects*

5. Personal Protective Equipment

Intent and Purpose

In this lesson the different types of Personal Protective Equipment (PPE), as well as their common uses and limitations will be presented. Personal Protective Equipment is utilized to reduce worker exposure to hazardous materials when other methods are inadequate. Included in this survey will be an analysis of those factors that should be considered in the selection of respiratory protective equipment, protective clothing, and head, eye, ear, hand and foot protection. The 4 EPA Levels of Protection will also be presented.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Describe** under what conditions Personal Protective Clothing (PPE) is required.
2. **List** 4 potential hazards in wearing & using PPE.

3. **Describe** what is permitted under the OSHA standard for workers who wear prescription glasses or contact lenses.
4. **Explain** what is the benefit in maintaining a positive pressure inside the facepiece.
5. **List** 4 limitations in using an Air Purifying Respirator (APR).
6. **Compare** the advantages & disadvantages between using a Self-Contained Breathing Apparatus (SCBA) and a Supplied-Air (Airline) Respirator (SAR).
7. **Describe** the principal components of a respiratory protection program under OSHA standard 29 CFR 1910.134.
8. **Describe** how the Protection Factor (PF) is determined, and how it is used to determine the maximum use limitation (MUL) for a given airborne contaminant.
9. **Describe** the 3 principal factors that affect chemical breakthrough time of Chemical Protective Clothing (CPC).
10. **List** 5 factors, other than those having to do with chemical resistance, that should be considered when selecting CPC.
11. **Explain** the units used in describing the thickness of CPC.
12. **Describe** the 4 EPA levels of protection (Levels A-D) with respect to respiratory and skin protection.

Lesson Outline

1. The lesson is introduced by considering the appropriate uses of Personal Protective Equipment, including:
 - The legal requirements to use PPE
 - The purpose of PPE
 - The hazards associated with the use of PPE
2. An introduction to Respiratory Protective Equipment is presented, including:
 - Selection factors to be considered
 - General limitations in using Respiratory Protective Equipment
 - Use of the Protection Factor (PF) in calculating the maximum use limitation (MUL) for a given airborne contaminant
 - The types, uses, advantages & limitations of the Air Purifying Respirator (APR)
 - The types, uses, advantages & limitations of the Self-Contained Breathing Apparatus (SCBA)
 - The types, uses, advantages & limitations of the Supplied-Air (Airline) Respirator (SAR)
 - NIOSH and MSHA as approval agencies for Respiratory Protective Equipment
 - Regulatory requirements of a respiratory protection program
 - The use of qualitative and quantitative fitting tests
3. An introduction to Chemical Protective Clothing (CPC) is presented, including:
 - The regulations pertaining to the use of protective clothing
 - The limitations of chemical protective clothing
 - Factors that affect chemical breakthrough time: permeation, degradation, and penetration

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- Other factors to be considered when selecting CPC
 - Examples of CPC, including their advantages & disadvantages
4. An introduction to the PPE for the different parts of the body is presented, including:
- The types of head protection
 - The types of eye protection
 - The types of ear protection
 - The types of hand protection
 - The types of foot protection
5. The 4 EPA Levels of Protection are briefly presented by describing the type of clothing, the degree of respiratory protection, the degree of skin protection, and the indications for using:
- Level A protection
 - Level B protection
 - Level C protection
 - Level D protection

Suggestions for Development and Presentation

In presenting this lesson the instructor should have available as many different types of PPE as possible to place on demonstration. While some students may have had much experience with PPE already, for many students this will be their first introduction to this subject. Short of having the actual equipment, or in addition to it, the instructor should utilize graphics (overheads; slides, etc.) and videos to show the full range of safety equipment available to meet the various occupational needs.

During the lesson the instructor should encourage student participation in describing the types, uses and limitations of PPE. Some are likely to have a few fascinating stories.
See Lesson 3: Control Measures; pp. 3-15 to 3-65 and pp. 3-93 to 3-

References and Resources

111 of HMTRI; Course HMT 280; *Hazardous Materials Health Effects*; 1988

Read "Personal Protective Equipment", chap. 8 from: NIOSH/OSHA/USCG/EPA; *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*; DHHS (NIOSH) Pub. No. 85-115; Oct. 1985; GPO No. 017-033-00426-9; available from: Superintendent of Documents; Government Printing Office; Washington D.C. 20402-9325; (202) 783-3238

NIOSH; *Pocket Guide to Chemical Hazards* (NIOSH Pub. No: 85-114); pp. 23-29; latest edition; available from the U.S. Government Printing Office

Also see c-23 "Respiratory Protective Equipment"; c-21 "Industrial Ventilation"; and c-22 "General Ventilation" in: B. Plog; *Fundamentals of Industrial Hygiene*; National Safety Council; 3rd ed (1988); available from National Safety Council; Order Processing; 1815 Landmeier Road; Elk Grove Village, IL 60007-2420; (800) 621-7619 available from ACGIH; catalog no: 0670; 6500 Glenway Ave.; Bldg. D-7; Cincinnati, OH 45211; (513) 661-7881

Read "Personnel Protective Equipment" in: *EPA Training Manual 165.5: Hazardous Materials Incident Response Operations*; available from ACGIH; catalog no: 3110; 6500 Glenway Ave.; Bldg. D-7; Cincinnati, OH 45211; (513) 661-7881

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments are:

Lesson 3: Control Measures; pp. 3-15 to 3-65 and pp. 3-93 to 3-111 of HMTRI; Course HMT 280; *Hazardous Materials Health Effects*

Read “Personal Protective Equipment”, chap. 8 from: *NIOSH/OSHA/USCG/EPA; Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*

Read pp. 23-29; *NIOSH; Pocket Guide to Chemical Hazards*

6. Medical Surveillance Program

Intent and Purpose

In this lesson the principles of a medical surveillance program will be introduced, and its use in complementing other exposure control methods will be considered. The types of medical screening tests and biological monitoring tests will be presented along with examples of toxic substances that can be assessed by each type of test. In addition the use of the Material Safety Data Sheet will be considered, especially focusing on Section 2 (Exposure Limits) and Section 6 (Health Hazard Data/Clinical Symptoms/First-Aid).

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Describe** which workers are required by the OSHA standard to be in a medical surveillance program.
2. **Explain** the value of medical surveillance.
3. **List** 7 factors that could affect an individual’s particular response to an exposure.
4. **Define** “total body burden”.
5. **Describe** the components of a Medical Surveillance Program.
6. **Describe** the rights of the worker in obtaining medical records.
7. **Describe** 3 categories of Biological Exposure Indices.
8. **Identify** an example of a common workplace substance being monitored for each of the following tests:
 - urine tests
 - blood analysis
 - breath analysis
 - hair analysis
 - liver enzyme tests
 - kidney function tests

9. *Describe* the types of information included in each of the seven sections of the MSDS.

Lesson Outline

1. The lesson is introduced by considering the purpose of medical surveillance, including:

- The legal requirements conducting medical surveillance
- Factors that can affect an individual's total body burden

2. The components of a Medical Surveillance Program are presented, including:

- Pre-employment medical screenings
- Annual (or more frequent) medical updates
- Biological monitoring for specific exposures
- Provisions for first-aid & medical emergencies
- Maintenance of medical records & reports of occupational injuries & illnesses

3. The types of Medical Screening Tests is presented, including:

- Physical examination
- Vision tests hearing (audiometric) tests
- EKG
- Chest X-rays
- Pulmonary Function Tests
- Liver Function Tests Kidney Function Tests
- Complete blood cell count & analysis (CBC)

4. The types of Biological monitoring tests is presented, including:

- The purpose of the tests
- Use of Biological Exposure Indices (BEI's)
- Urine Tests
- Blood Analysis
- Breath Analysis
- Hair & Nails Analysis

5. The Use of Material Safety Data Sheets (MSDS)

Suggestions for Development and Presentation

Instructors presenting this lesson might wish to review their clinical physiology. A very good review of clinical laboratory tests that I would suggest is: Kathleen M. Treseler; *Clinical Laboratory Tests; Significance and Implications for Nursing*; Prentice-Hall; 1982. I would also suggest showing students one or more examples of a blood and urinalysis laboratory report, available from hospitals, etc.

This lesson would lend itself to inviting an industrial hygienist, occupational health nurse, occupational health physician, or public health officer to speak to the class.

References and Resources

See Lesson 3: Control Measures; p. 3-69 of HMTRI; Course HMT 280; *Hazardous Materials Health Effects*, 1988

Read “Medical Program”, chap. 5 from: NIOSH/OSHA/USCG/EPA; *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*; DHHS (NIOSH) Pub. No. 85-115; Oct. 1985; GPO No. 017-033-00426-9; available from: Superintendent of Documents; Government Printing Office; Washington D.C. 20402-9325; (202) 783-3238

Read: “Material Safety Data Sheet (MSDS) from: Hazard Communication: A Compliance Kit (OSHA Pub. no. 3104); U.S. Dept. of Labor; 1988

Also read: “Industrial Toxicology”, pp. 377-383 (chap. 15) from: B. Plog; *Fundamentals of Industrial Hygiene*; National Safety Council; 3rd ed (1988); available from National Safety Council; Order Processing; 1815 Landmeier Road; Elk Grove Village, IL 60007-2420; (800) 621-7619 available from ACGIH; catalog no: 0670; 6500 Glenway Ave.; Bldg. D-7; Cincinnati, OH 45211; (513) 661-7881

This lesson is suggested to take 3 hours of classroom instruction.

Schedule and Assignments

Student reading/study assignments are:

Lesson 3: Control Measures; p. 3-69 of HMTRI; Course HMT 280; *Hazardous Materials Health Effects*

Students should have the “Medical Program”, chap. 5 from: NIOSH/OSHA/USCG/EPA; *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* to read

Introduction to Waste Streams Generation, Treatment and Reduction

Chapter 1

Intent and Approach

“Waste Streams” is a course intended to familiarize students with the broad concepts of the operation and terminology of various industries and industrial processes. Emphasis is placed on the generation, treatment and reduction of hazardous and non-hazardous waste products.

Sample industries will be used to study industrial processes, engineering problems, and economic alternatives as they relate to waste generation and reduction techniques and regulations that impact the response of industries.

Lesson Objectives

To successfully complete this lesson the student will be able to:

1. Define the basic terminology used in pollution prevention
2. Recall what federal, state, and local laws pertain to the governing of hazardous waste generation, reduction and treatment.
3. Explain “the material balance” concept as it relates to manufacturing process.
4. Contrast industries where the material balance concept is a useful tool to industry with those where the concept is not practical.
5. Explain the difference between batch and continuous flow process
6. Identify various types of industries associated with hazardous waste stream generation.

Lesson Outline

1. Discuss the EHMT Program, and how “waste streams” fits into the program.
2. Define the goals and expectations of the course.
 - a. Discuss the grading scale.
 - b. Identify the required textbook(s) and materials.
 - c. Discuss attendance policies and homework policy.
3. Provide students with a current Glossary of Pollution Prevention terms and Environmental Acronyms associated with this course.
4. Present a brief overview of any Federal, State, or local law(s) which apply to this course
 - a. RCRA
 - b. EPA
 - c. SB14
5. Compare the following terms, or set of terms.
 - a. Batch and continuous flow process
 - b. Input vs. output
 - c. Raw material vs. Product
 - d. Material Balance
6. Identify the types of industries to be addressed in this course.

Suggestions for Development and Presentation

It is essential that the students have a clear understanding of the direction and purpose of this course. It would be helpful if the students begin with Pollution Prevention Terminology. This will help the student to obtain a common language associated with this course.

It is strongly suggested that a variety of audio visual media be applied to the course.

Be certain the students understand the concepts in Section 5 of the course outline and provide examples to each.

Reference and Resources

Introduction to Environmental Hazardous Material Technology Textbook, Bakersfield College 1972

Schedule and Assignments

Three classroom hours are suggested for this lesson.

Suggested assignments would be to become familiarized with:

- a. Terminology
- b. waste generation of a selected industry

Waste Stream Regulations

Chapter 2

Intent and Approach

This lesson will provide an introduction to the various regulatory programs that effect the handling and management of hazardous materials, hazardous wastes, and air and water emissions from industrial generators.

Lesson Objectives

To successfully complete this lesson the student will be able to:

1. Name and describe the environmental laws and regulations, that affect water (effluent) discharges, air emissions, and solid and hazardous waste streams that come from industry.
2. List information sources that can be utilized to obtain data on the emissions of various industries.
3. Enumerate how waste stream regulations influence:
 - a. external plant material and product flows
 - b. internal plant flow and handling
 - c. effluent
 - d. loss of materials and profits
 - e. waste streams
 - f. emissions
4. Recognize the involvement of the public in lobbying for increased regulation of industrial waste.
5. Recognize the role industry must place on itself toward the community and public relations.
6. Recognize the value of waste stream reduction and the advantage of being classified as a small quantity generator.

Lesson Outline

I Federal and State Laws

A. Federal

- a. Federal Insecticide Fungicide and Rodenticide Act (FIRFA) (1947)
- b. Clean Air Act (1955) and Amendments (1960-1990)
- c. National Environmental Policy Act (NEPA) (1970)
- d. Safe Drinking Water Act (1976) and Amendments (1977-1986)
- e. Resource Conservation and Recovery Act (RCRA) (1976) and Amendments (1980-1984)
- f. Toxic Substance and Control Act (TSCA) (1976)
- g. Comprehensive Environmental Response, Compensation, and Liability Act. (CERCLA, Known as the “Superfund Act”) (1980) and Amendment (1988)

B. State of California

- a. California Environmental Quality Act (CEQA) (1970) Public Resources Code Secs. 2100-21177
- b. California Clean Air Act (1988) Secs (39610) (40911) (40914) (40918-40921). Nonvehicular Air pollution Sec. (3960 a & b) (41700) (49010-49011) (42300-42301) (42350-42352) (42400) et seq. Kapiloff Acid Deposition Act (1982) repealed 1988 Atmospheric Acidity Protection Act (1988) Secs. (39900-39911). Air toxics “Hot Spots” Information and Assessment Act (1987) Secs. (44300-44384). Vehicle Air Pollution (ARB’s) responsibility for reducing and regulating pollution from motor vehicles, Secs. (39002,39003. 39500, 43000) et seq.
- c. Porter-Cologne Water Quality Control Act (1969) Water Code Secs. (1300-13999.18) CCR, Title 23 Chapter 23
- d. California Safe Drinking Water Act (1976) Health and Safety Code Secs. (4010.1(b), 4026(a).
- e. Toxic Injection Well Control Act (1985) Health and Safety Code Secs. (25159.10-25159.25)
- f. Safe Drinking Water and Toxics Enforcement Act (1986) Health and Safety Code Secs.(25249.5-25249.11) (25189.5, 25192.2)
- g. Hazardous Substance Act (1961) Health and Safety Code Sect. (28740-28797)
- h. Hazardous Substance Information and training Act (1980) Labor Code Secs. (6360-6399.7) “Worker Right To Know Law”.
- i. Occupational Carcinogens Control Act (1976) Labor Code Secs (9000- 9061)
- j. Hazardous Material Release Response Plan and Inventory (1985) “Community Right To Know Law” Health and Safety Code Secs. (25500-25521)
 1. Storage of Hazardous Substance (1983) Health and Safety Code Secs. (25299.82-27250) “Underground Storage Tanks”.
 2. Information Sources for data on waste stream generation, emissions, and storage of hazardous materials in industry.
 - a. SARA Title III “Community Right to Know” regulations
 - b. OSHA Hazard Communication Standard
 - c. AB 2187 Hazardous Material Disclosure
 3. How waste stream regulations influence:
 - a. external plant material and product flows (provide information on selected industries)
 - b. internal plant flow and handling (eg) batch production, housekeeping, employee training, Scheduling, preventive maintenance etc.
 - c. Effluent (example processes of treatment, separation, filtration, exchange, etc).
 - d. Loss of materials and profits- Better Operating Practices, Personnel Practices, Standard Procedures
 - e. Waste streams- Production process change, Recycling and Reuse, Inventory Management, Improve Operations.
 - f. Emissions- Modification of equipment, Preventive Maintenance, Modify equipment to enhance recovery.

4. Involvement of public in lobbying
 - a. Process and procedures
 - b. Advantages to overall environmental responsibility.
5. Industry role in community and public relations
 - a. Industry should adopt its own general plan for waste minimization and, define that program formally in a written program.
 - b. Industry should make every attempt to insure the public of its environmental commitment.
 - c. Industry should have a sound hazard communication program and welcome both private and public input.
6. Waste stream reduction and the advantages of being a small quantity generator.
 - a. Capital expense reduction
 - b. Reduced financial liabilities
 - c. The less waste generated, the lower the potential for negative environmental effects.
 - d. Permit fee reduction

Suggestion for Development and Presentation

Three to six hours may be necessary for this lesson. Students may have to be brought back up to speed with the environmental laws and regulations. Guest speakers from local regulatory agencies would provide a good resource.

References and Resources

Cal-EPA Office of Environmental Health Hazard Assessment. Hazard Identification and Risk Assessment Branch. Tox- EPI Review.

U.S. Environmental Protection Agency. Various pamphlets describing EPA laws it administers.
Introduction to Environmental Hazardous Material Technology textbook, Bakersfield College, 1972

Suggested Assignments

General review of chapter 2 content.
Paper on selected law(s) or course objective.

Applications of Waste Stream Reduction and Treatment Technologies

Chapter 3

Intent and Approach

This lesson will provide an introduction of the four basic treatment technologies and their basic applications. In addition several block flow diagrams will be provided to enable you to understand the applied technologies

Lesson Objectives

To successfully complete the lesson the student will be able to:

1. Recognize the four basic treatment technologies and their basic applications
2. Demonstrate the ability to read and understand block flow diagrams.

Lesson Outline

I. Four basic treatment technologies:

A. Chemical Treatment Aqueous

- a. Oil/ Water (Emulsion Breaking) Use of chemicals an/ or polymers
- b. Metal Removal (Chemical Precipitation) Hydroxide precipitation, Sulfide precipitation, Chrome reduction
- c. Organic Removal (Chemical Oxidation)
- d. Sludge treatment (Anaerobic Digestion)

B. Chemical Treatment for Contaminated Soils

- a. Organic Compounds (Bioremediation)
- b. Metals (Chemical Fixation)

C. Biological Treatment Aqueous

- a. Organic Removal (Anaerobic and Aerobic, Nitrification and Denitrification, Sulfate Reduction, Reductive Dechlorination).

D. Biological Treatment for Contaminated Soils

- a. Bioremediation (In situ, Land farming)

E. Physical Treatment Aqueous

- a. Oil/ water (Oil Separation, Filtration, Ultra Filtration, Kleensorb Adsorption)
- b. Suspended Solids (Sedimentation, Flotation, Granular Media Filtration)
- c. Metal Removal (Ion Exchange, Reverse Granular)
- d. Organic Removal (Air stripping and Steam Stripping, Carbon Absorption).
- e. Inorganic Salts Removal (Reverse Granular, Ion Exchange, Electrodialysis).
- f. Sludge Treatment (Thickening , Dewatering, Drying, Composting.

F. Physical Treatment for Contaminates Soils

- a. Aeration, Vacuum Extraction (In situ).

G. Thermal Treatment Aqueous

- a. Sludge Treatment (Incineration, Fuels Program)

F. Thermal Treatment For Contaminated Soils

- a. Steam Stripping
- b. Incineration

Suggestions for Development and Presentation

Three hours are suggested for this lesson. Since block flow diagrams are an objective, either selected handouts should be presented or overhead transparencies (preferred) are adequate . The instructor can utilize audio visuals or a slide presentation to enhance the objectives.

References and Resources

Standard Handbook of Hazardous Waste Treatment and Disposal Harry M. Freeman, Editor in Chief
Publisher Mc Graw Hill

Technologies For Storage, Treatment, And Disposal of Hazardous Materials.

Environmental Hazard Management Program, University Extension University of California Seminar Davis, California.

Suggested Assignments

General review of Chapter 3 content

Paper on treatment technologies and/ or block flow diagram

Physical Treatment Technologies

Chapter 4

Intent and Approach

This lesson will provide an introduction to the various physical treatment technologies along with their availability/ limitations.

Lesson Objectives

To successfully complete this lesson the student will be able to:

1. Describe various physical treatment Technologies associated with:
 - a. Liquid/ solid separation
 - b. Phase separation
 - c. Dissolution
 - d. Size, Adsorptivity, Ion Characteristics:

Lesson Outline

1. Describe/ Define the following:
 - A. Liquid/ Solid Separation (Gravity Separation)
 - a. Sedimentation
 - b. Centrifugation
 - c. Flocculation
 - d. Oil/ Water Separation
 - e. Dissolved Air Flotation
 - f. Heavy Media Separation
 - B. Phase Separation
 - a. Evaporation
 - b. Air stripping
 - c. Steam Stripping
 - d. Distillation
 - C. Dissolution
 - a. Soil Washing/ Flushing
 - b. Chelation
 - c. Liquid/ Liquid Extraction
 - d. Supercritical Solvent Extraction
 - D. Size, Adsorptivity, Ion, Characteristics
 - a. Filtration
 - a. Carbon Adsorption
 - c. Reverse Osmosis
 - d. Ion Exchange
 - e. Electrodialysis

Suggestions for Development and Presentation

Each section in the lesson outline should be exemplified along with explanations of availability and limitations. Flow charts and/or diagrams (overhead projector) are recommended.

References and Resources

Standard Handbook of Hazardous Waste Treatment and Disposal
Harry M. Freeman, Editor in Chief
Publisher McGraw Hill

Technologies For Storage, Treatment, And Disposal of Hazardous Materials.
Environmental Hazard Management Program, University Extension University of California Sminar Davis, California.

Suggested Assignments

General Review of Chapter 4
Provide paper on course content.

Chemical Treatment Technologies

Chapter 5

Intent and Approach

This lesson will describe various chemical treatment technologies and their relevant applications to waste stream management, availability and limitations.

Lesson Objectives

To successfully complete this lesson the student will be able to:

1. Describe the various chemical treatment technologies associated with:
 - a. Neutralization/ precipitation
 - b. Oxidation reduction
 - c. Dechlorination
 - d. Ion exchange
2. Discuss the applicability and limitations as applied to the above technologies.
3. Understand the important chemical treatment data needed for evaluating and comparing chemical treatment needs.

Lesson Outline

1. Describe/Define the following, along with their applicability and limitations:
 - A. Neutralization (pH adjustment)
 - B. Chemical Precipitation
 - C. Hydrolysis and Photolysis
 - D. Oxidation and Reduction

- E. Hydrogen Peroxide Oxidation
- F. Ozonation
- G. Alkaline Chlorination
- H. Hypochlorite Chlorination
- I. Electrolytic Oxidation
- J. Chemical Dechlorination

2. Identify and explain the purpose for chemical data needed to evaluate and compare, above chemical treatment technologies.

- A. pH (pH adjustment)
- B. Turbidity/ Opacity (Photolysis)
- C. Constituted analysis (treatment needs)
- D. Halogen Content (dehalogenation)

Suggestions for Development and Presentation

Each section in the lesson outline should be exemplified along with explanations of availability and limitations. Flow charts and / or diagrams (overhead projector) are recommended.

References and Resources

Standard Handbook of Hazardous Waste Treatment and Disposal
Harry M. Freeman, Editor in Chief
Publisher McGraw Hill

Technologies For Storage, Treatment, And Disposal of Hazardous Materials.
Environmental Hazard Management Program, University Extension University of California Seminar Davis, California.

Alternate Technologies For the Minimization of Hazardous Waste Report.
California Department of Health Services
Toxic Substance Control Program
Alternative Technology Division
July 1990

Suggested Assignments

General Review of Chapter 5
Provide paper on course content.
Have students become familiar with concepts of the Biological processes in Chapter 6.

Biological Treatment Technologies

Chapter 6

Intent and Approach

This lesson will describe various Biological treatment technologies and their relevant applications to waste stream management, availability the limitations.

Lesson Objective

To successfully complete this lesson the student will be able to:

1. Describe the various Biological treatment technologies associated with:
 - a. Aerobic Biological Treatment
 - b. Activated Sludge
 - c. Rotating Biological Contactors
 - d. Bioreclamation
 - e. Anaerobic Digestion
2. Discuss the applicability and limitations as applied to the above technologies.
3. Understand the important biological treatment data needed for evaluation and comparing biological treatment needs.

Lesson Outline

1. Describe/ Define the following, along with their applicability and limitations:
 - a. Aerobic Biological Treatment (BOD)
 - b. Activated Sludge (aerobic microorganisms)
 - c. Rotating Biological Contactors (microbial film and the atmosphere)
 - d. Bioreclamation (aerobic microbial degradation)
 - e. Anaerobic Digestion (bacteria)
2. Identify and explain the purpose for biological data needed to evaluate and compare, above biological treatment technologies.
 - a. Gross Organic Component(s) (treatment standard)
 - b. Priority Pollutant Analysis (toxicity for processing microbes).
 - c. Dissolved Oxygen (aerobic reaction rates/Interference's).
 - d. Nutrient Analysis (nutrient requirements)
 - e. pH (pH adjustment)

Suggestions for Development and Presentation

Each section in the lesson outline should be exemplified along with explanations of availability and limitations.

Provide examples for Biological Remediation (an excellent example would be the success with these processes after a underground tank removal project).

References and Resources

Standard Handbook of Hazardous Waste Treatment and Disposal Harry M. Freeman, Editor in Chief Publisher McGraw Hill

Technologies For Storage, Treatment, And Disposal of Hazardous Materials. Environmental Hazard Management Program, University Extension University of California Seminar Davis, California.

Alternate Technologies For the Minimization of Hazardous Waste Report. California Department of Health Services Toxic Substance Control Program Alternative Technology Division July 1990

Suggested Assignments

General Review of Chapter 6 Provide paper on course content. Have students become familiar with concepts of the Thermal Treatment processes in chapter 7.

Thermal Treatment Technologies

Chapter 7

Intent and Approach

This lesson will describe various Thermal treatment technologies and their relevant applications to waste stream management, availability and limitations.

Lesson Objectives

To successfully complete this lesson the student will be able to:

1. Describe the various Thermal treatment technologies associated with:
 - a. Liquid Injection Incineration
 - b. Rotary Kiln Incineration
 - c. Pyrolysis
 - d. Wet Air Oxidation
2. Discuss the applicability and limitations as applied to the above technologies.
3. Understand the important biological treatment data needed for evaluating and comparing biological treatment needs.

Lesson Outline

1. Describe/Define the following, along with their applicability and limitations:
 - a. Liquid Injection Incineration (mixing of air with fuel, sprayed with nozzles)
 - b. Rotary Kiln Incineration (kiln tumbles as waste is incinerated)
 - c. Pyrolysis (chemical decomposition of waste heating material in the absence or oxygen)
 - d. Wet Air Oxidation (uses elevated temperature pressure to oxidize dissolved organics)
2. Identify and explain the purpose for thermal data needed to evaluate and compare, above biological treatment technologies.
 - a. Heat Content (Combustibility)
 - b. Ash Content and Characteristics (furnace design, ash handling)
 - c. Halogen Content (refractory design, APC requirements)
 - d. Moisture Content (auxiliary fuel requirements)
 - e. Heavy Metal Content (APC control/requirements)
 - f. Volatile content (furnace design)

Suggestions for Development and Presentation

Each section in the lesson outline should be exemplified along with explanations of availability and limitations.

Provide additional examples of thermal treatment. Suggested technologies are those in either the demonstration or evaluation stages.

References and Resources

Standard Handbook of Hazardous Waste Treatment and Disposal Harry M. Freeman, Editor in Chief Publisher McGraw Hill

Technologies For Storage, Treatment, And Disposal of Hazardous Materials. Environmental Hazard Management Program, University Extension University of California Seminar Davis, California.

Alternate Technologies For the Minimization of Hazardous Waste Report. California Department of Health Services Toxic Substance Control Program Alternative Technology Division July 1990

Incinerable Hazardous Waste Minimization Proceedings California Department of Health Services Toxic Substance Control Program Alternative Technology Division

Suggested Assignments

General Review of Chapter 7 Provide paper on course content. Have students become familiar with concepts in chapter 8.

Pollution Prevention and Waste Minimization

Chapter 8

Intent and Approach

New regulations limiting land disposal of hazardous waste and rising costs of waste management provide incentives for generators to reduce the amount of hazardous waste they generate. Waste reduction is an appealing approach because it can reduce the costs of hazardous waste management while also reducing the amount of waste destined for land disposal.

Lesson Objectives

To successfully complete this lesson the student will be able to:

1. Recall and discuss regulatory requirements for pollution prevention and waste minimization.
2. Recall the waste management hierarchy Describe and compare techniques used in the waste management hierarchy.
3. List the steps involved in conducting a waste minimization assessment.
4. Provide examples of incentives for pollution prevention and waste minimization both in industry and small waste generation.

Lesson Outline

1. Regulatory requirements for pollution prevention and waste minimization.

- A. Hazardous waste Source Reduction and Management Review act of 1989. (Article 11.9 of chapter 6.9 of Division 20 of the Health and Safety code commencing with section 25244.12). Businesses that are subject to the act must prepare one of the two sets of documents:

- a. Source Reduction Evaluation Review and Plan, Plan summary, Hazardous waste management performance report, Report summary and Progress report.
 - b. Compliance Checklist and progress Report.
- B. SB 1772, added by Statutes of 1992 as Chapter 853
 - a. Broadens the applicability of the act (above) by including any generator who was not previously subject to the act and:
 - 1. generates more than 5000 kilograms of specified hazardous waste in a reporting year.
 - 2. Must prepare either a Compliance Checklist or a Source Reduction Evaluation Review and plan
- C. Pollution Prevention act of 1990
 - a. Reinforces the EPA's Environmental Management Option Hierarchy by assigning highest priority to preventing pollution through source reduction and reuse.
- D. Sb 14 (Roberti)
 - a. Adopts format for generator source reduction, plans and performance report
 - b. Establishes data system for categories of waste streams, evaluating waste reduction reviews, evaluating whole waste reduction programs.
 - c. Technical and research assistance programs
 - d. Identifies categories of waste for regulatory focus
 - e. Conducts source reduction evaluations.
 - f. Prepares hazardous waste management performance report
 - g. Requires Director to prepare a report to the Legislature and Governor describing the status of the hazardous waste reduction program, and make recommendations
- 2. Waste Management Hierarchy
 - a. Source Reduction
 - b. Recycling
 - c. Treatment
 - d. Land disposal
- 3. Provide examples to the Waste Management Hierarchy
- 4. Waste Minimization assessment
 - A. Assessment
 - a. Identify types and amounts of waste generated by your industry.
 - b. identify major material losses and cause
 - c. identify and evaluate potential waste reduction methods.
 - d. itemize current waste management costs of different waste reduction practices
 - e. create a team of line, engineering and management staff for input of waste management
 - f. provide for and obtain a complete material balance approach.
 - B. Improve operating practices (good housekeeping)
 - a. inventory
 - b. segregation of waste
 - c. preventing and controlling of spills and leaks
 - d. containing spills
 - C. Material substitution (nonhazardous vs. hazardous waste) ?
 - D. Product substitution (changing of product altogether to a lesser hazard or none at all).
 - E. Process Modification (replacement of inefficient or Checklist or a Source Reduction Evaluation Review and plan
 - F. Technology Modification (making changes in production process).
 - a. changes in placement or order of equipment
 - b. equipment modifications
 - c. changes in operation setting or schedules
 - e. automation

5. Waste Management Incentives

- a. saves money through more effective use of valuable resources and reduced waste treatment disposal costs,
- b. Reduction of generators hazardous waste financial liabilities.
- c. Reduction of waste promotes good public relations though generators commitments.

Suggestions for Development and Presentation

Each section in the lesson outline should be exemplified.

References and Resources

Hazardous Waste Source Reduction Guidance Manual
California Dept. of Toxic Substances Control
Office of Pollution Prevention and Technology Development
May 1994

Facility Pollution Prevention Guide
US EPA
Office of Research and Development
May 1992

Standard Handbook of Hazardous Waste Treatment and Disposal
Harry M. Freeman, Editor in Chief
Publisher Mc Graw Hill

Technologies For Storage, Treatment, And Disposal of Hazardous Materials. Environmental Hazard Management Program, University Extension University of California Seminar Davis, California.

Suggested Assignments

Provide students with sampled format as supplied in Hazardous Waste Source Reduction Guidance Manual and conduct their own source reduction assessment.

Have students become familiar with concepts in chapter 9

Waste Stream Source Reduction From the Plating and Finishing Industries

Chapter 9

Intent and Approach

This section will highlight and discuss a some of the techniques currently in use to reduce the volume and/or toxicity of metal bearing waste streams generated by the metal plating industry.

Lesson Objectives

To successfully complete this lesson the student will be able to:

1. Explain the basic process involved in metal plating and finishing industries.
2. Recall common waste streams generated by this industry.
3. Describe waste reduction and minimization opportunities available to this industry.
4. Recall various regulations that pertain to this industry.

Lesson Outline

1. Basic Metal plating processes
 - A. 3 key steps:
 - a. pretreatment (prepares work piece for treatment)
 - b. electroplating (cathode, electrolyte solution, electric current)
 - c. posttreatment (rinsing of workpiece to remove containments).
 - B. Metal Finishing Process general aims are to change the surface of a product to:
 - a. improve corrosion resistance
 - b. make the appearance more pleasing
 - c. improve hardness
 - d. increase wear resistance
 - e. change surface conductivity
 - f. finish to suite specific engineering needs
2. Basic Waste streams (supplied handout)
 - a. Process stream
 - b. metal
 - c. component of bath that may be released into the atmosphere
 - d. physical and chemical nature of major atmospheric contaminant
3. Waste reduction and minimization opportunities available to this industry.
 - A. Material substitution
 - a. deionized water (greatest impact and widest application in the reduction of waste generation) example: less volume of rinse water solutions.
 - b. non-cyanide plating solutions (eliminates completely a process chemistry component which not only requires a special pretreatment activity, but is a major health and safety issue). Possible alternatives:
 - a. Zinc Chloride
 - b. Alkaline zinc
 - c. trivalent chromium plating and chromating solutions (reduces substantially the health risk associated with hexavalent chromium process solutions, and trivalent chromium process are much more diluted than hexavalent thus reducing a pretreatment step).
 - B. Process Modification (changes in equipment which leads to reduced generation of waste)
 - a. drain boards (should be oriented to direct drips into the correct solutions.
 - b. agitation-solution and air (when used in a rinse system can lower rinse water volumes by creating turbulence which enhances process solution removal and enables less water to do more work).
 - c. Flow Restrictors (Placed directly in the inlet to a rinse tank, they restrict the flow of rinse water to a predetermined level)
 - d. dragout recovery (uses a non-flowing rinse, or empty tank to capture process solutions foe eventual return to the process tank)

Environmental Technology

C. Modified Operating Practices (changes which are dependent on human participation to effect a reduction in waste generation).

- a. process solution control (plant operators would be encouraged to strive to reduce or eliminate premature disposal and achieve solution controls through tracking of containment's before discharging.
- b. training and education (operators should understand the consequences of spills, leaks , overflows, and the destination of all wastes both immediate and eventual.
- c. housekeeping (Spills, leaks, overflows should be minimized and/or eliminated. Inventory should be protected especially from moisture. Some of the most expensive wastes to dispose of are unusable raw materials.

4. Various regulations that pertain to this industry.

- a. Clean Air Act
- b. Safe Drinking Water Act
- c. Clean Water Act
- d. Resource Conservation and Recovery Act
- e. OSHA

Suggestions for Development and Presentation

Each section in the lesson outline should be example.

References and Resources

Hazardous Waste Source Reduction Guidance Manual California Dept. of Toxic Substances Control Office of Pollution Prevention and Technology Development May 1994

Metal Waste Management Alternatives California Dept. of Toxic Substances Control Office of Pollution Prevention and Technology Development 1989 Symposium Proceedings

Suggested Assignments

Have students become familiar with the course content in the next chapter.

Wastes From the Farm/Agriculture Industry

Chapter 10

Intent and Approach

This chapter will concentrate on disease causing microorganisms that can inhabit household and milkhouse wastewater disposal systems, barnyard and feed lot areas, and livestock waste storage and handling systems.

“Septic systems represent the largest reported cause of groundwater contamination resulting in disease outbreaks in the U.S.” -- the Center for Disease Control.

Lesson Objectives

To successfully complete this lesson the student will be able to:

1. Describe basic actions that can reduce pollution risk at most sites.
2. Describe the limitations and preventative measures for conventional (septic) household wastewater handling system
3. Describe the limitations of a milkhouse waste handling system.
4. Describe several types of systems used for long-term and temporary storage of livestock wastes and livestock holding areas.
5. Identify what problems exist with improperly abandoned or constructed wells.

Lesson Outline

1. Several basic actions that can reduce farm/agriculture pollution risk.

- a. maintaining adequate separation distances between contamination sources and wells (used and unused)
- b. diverting contaminated surface water runoff away from the well area.
- c. proper collection of and/or disposing of contaminated waste material.
- d. prevention of contaminated water from flowing directly into groundwater through sink holes, crevices in bedrock, unused wells or poorly designed or located wells.

2. Conventional household (septic) wastewater handling system.

A Limitations:

- a. Must be designed to prevent surface ponding of wastewater
- b. Must provide an adequate soil filter between the bottom of the absorption fields and either ground water or bedrock.
- c. If properly installed and maintained, microorganisms will be filtered and trapped in this layer where they eventually die.

B. Preventative Measures:

- a. Septic systems should be pumped at least every three years
- b. a separation of at least three feet should be maintained between the bottom of the septic system drain field and bedrock or water table.
- c. subsurface disposal of septic system effluent should be at least 50 feet from wells.
- d. The lowest pollution risk occurs when at least six feet of medium to fine textured soil is maintains between the potential pollution source and the water table or bedrock.

3. Milkhouse Waste handling Systems A. Methods

- a. usually handled in septic systems
- b. Direct surface discharge

c. mixed with livestock waste B. Preventative Measures:

- a. Follow design and maintenance requirements for household systems.
- b. minimize the amount of milk disposed in the system.
- c. pump waste water to properly designed and managed liquid livestock waste storage facilities.
- d. If surface discharges are allowed, the point of discharge should be at least 200 feet from a well preferably down slope on a medium to fine texture soil.

4. Livestock Waste and Holding Areas A. Methods

- a. several types of systems are used for long term and temporary storage of livestock wastes
- b. liquid tight systems present the lowest risk to groundwater contamination (if properly maintained).
- c. Earthen storage pits (greater risk) especially if either liners or poor design become damaged.

B Preventative measures

- a. caution must be exercised to prevent damaging earthen storage liners during emptying and filling.
- b. liners should be inspected frequently.
- c. risk is significantly reduced for temporary storage if concrete slabs with curbs and gutters are used.
- d. If runoff from livestock holding areas flows towards existing or abandoned wells, the water should be diverted away from the wells and allowed to filter through medium to fine textured soils.

5. Problems that exist with improperly abandoned or constructed wells.

- a. Wells with corroded or cracked casings must have new casings installed or the well must be properly abandoned otherwise wells can be conduits for microorganisms to enter the ground water.
- b. well casings are not deep enough to ensure adequate filtration of recharged water
- c. water tight seals are not installed or maintained at the base of the hand pump
- d. drilling equipment, pipes and pumps are not disinfected during new well construction.

Suggestions for Development and Presentation

Each section in the lesson outline should be example.

References and Resources

Protecting the farmstead well from Microorganisms Fact Sheet Gary w. Jackson
Extension service Coordinator

U.S.D.A. Hydrologic Unit Area Fact Sheet U.S.D.A. Farm * A* Syst

Suggested Assignments

Have students become familiar with the course content in the next chapter.

Pesticide Formulating Industry

Chapter 11

Intent and Approach

The pesticide industry is comprised of roughly 330 establishments nationwide. Approximately 598 of the establishments are located in 10 states, although no one state accounts for a major share of the industry. Most of the establishments are located near the agriculture areas which make use of the products. These products includes insecticides, herbicides, and fungicides.

Lesson Objectives

To successfully complete this lesson the student will be able to:

1. Describe the classification of most pesticides
2. Describe the three types of pesticide formulations
3. Recall the two major steps in the production of pesticides.
4. Recall the process waste categories associated with liquid waste formulation process
5. Recall the process waste categories associated with the dry pesticide formulation process
6. Describe the waste minimization options

Lesson Outline

1. Classification of most pesticides
 - a. Insecticides
 - b. Herbicides
 - c. Fungicides
2. Three types of pesticide formulations
 - a. Solvent based
 - b. Water based
 - c. Solid based
3. Two major steps in the production of pesticides
 - a. Manufacturing of the pesticide concentrate from basic chemical feed stocks including petrochemicals, inorganic acids, gases such as chlorine and other chemicals.
 - b. Formulation and preparation of the pesticide for final use. The process used to formulate pesticides generally consist of blending operations where the active ingredients are mixed with the inert ingredients previously mentioned
4. Process waste categories associated with liquid waste formulation process. (refer to handout)
 - a. Waste rinse water
 - b. waste cleaning solvents
 - c. discarded raw material container
 - d. pesticide dusts
 - e. off specification products
 - f. evaporative losses of volatile organic compounds
5. Process waste categories associated with the dry pesticide formulation process. (refer to handout)
 - a. waste rinse water
 - b. waste cleaning solvents
 - c. discarded raw material container
 - d. pesticide dusts e. off specification products
6. Waste minimization options
 - a. Waste stream segregation
 - b. Personnel practices (management initiatives, training, employee incentives).
 - c. Procedural measures (documentation, material tracking and handling, inventory control, scheduling).
 - d. Additional Minimization methods include but are not limited to equipment cleaning wastes, spills and area washdowns, containers, air emissions , and miscellaneous wastewater streams.

Suggestions for Development and Presentation

Each section in the lesson outline should be example.

References and Resources

Guide to Pollution Prevention The Pesticide Formulating Industry United States Environmental Protection Agency
Risk Reduction Engineering Laboratory February 1990

Schedule and Assignments

Have students become familiar with the course content in the next chapter.

Marine Maintenance and Repair

Chapter 12

Intent and Approach

This industry varies widely in size and type of operations. Boat repair yards service recreational and small commercial craft. Large shipyards build and repair freighters, tankers, liners, and naval vessels.

Lesson Objectives

To successfully complete this lesson the student will be able to:

1. Describe what operations and wastestreams that are associated with large ship yards operations
2. Identify various waste stream minimization procedures associated with ship yard operations

Lesson Outline

1. Large ship yards
 - A. Ship yard operations include:
 - a. painting
 - b. powerplant maintenance
 - c. machine shops
 - d. electroplating
 - e. air conditioning and refrigeration service
 - f. electrical repair
 - g. pipefitting and cleaning
 - B. Wastestreams
 - a. Paint removal wastes (major waste problem at marine yards)
 - 1) preparation may require washing with solvents, bleach, or detergents
 - 2) surface preparation by abrasive blasting or chemical stripping
 - 3) scraping, sanding or thermal stripping
 - 4) chemical strippers contain toxic compounds, (aluminum hulls are acid etched prior to painting generating acidic wastewater).
 - b. Abrasive blast wastes
 - 1) should be tested by a department certified lab to determine weather the waste should be handled as a hazardous waste.
 - c. Paints and Primers
 - 1) include water and solvent based paints, epoxies, enamels, lacquers, and varnishes
 - d. Fiberglass repair of hulls
 - 1) may require resins and hardeners, gel coats, release agents and degreasing agents.
 - 2) Fiberglass paint application include paint thinners, wash solvents, cleaning solvents (acetone, MEK, mineral spirits, alcohol and gasoline).
 - e. Engine Service (small yards)
 - 1) lubricants, hydraulic fluids, carburetor cleaners, hexane and other solvents, cutting fluids, acetone, MEK, and chlorinated solvents.

- f. Engine Service (large yards)
 - 1) caustics boiler cleaning wastes
 - 2) waste from sheet metal shops, pattern shops, air conditioning and refrigeration repair and metal finishing.
 - 3) degreasing solvents, acid and alkaline cleaning wastes, chromic acid, contaminated rinse water, isocyanates, phenols, cresols, CFC solvents, and electroplating wastes.
- g. Bilge waste
 - 1) oils and fuels
- h. Older ships
 - 1) asbestos waste (when older ships are refurbished)
- i. Vessel sanitary systems
 - 1) caustic chemical cleaning waste
- 2. Waste stream minimization procedures associated with ship yard operations
 - A. Paint removal wastes
 - a. may be minimized by switching to another paint removal method that may be available
 - b. paint overspray and removal wastes should be contained within tarps or HDPE and not be allowed to wash into the harbor surface water
 - B. Paints and primers
 - a. careful handling and segregation of the spent solvents and thinners would allow their reuse for further paint applications.
 - b. excess paint can be given to a customer for touchups.
 - c. Improving inventory control
 - C. Large and small ship yards
 - a. reduction in these operations are
 - 1) waste segregation
 - 2) reuse of materials
 - 3) recycling of spent material
 - 4) improve or alternate procedures
 - 5) substitution of a hazardous material with a biodegradable or nonhazardous material(s).
 - D. Rainwater runoff and spills (due to inadequate spill control)
 - a. Install collection systems or skimmer down gradient from yard.
 - b. use of product transfer pumps or spigots and collection trays (as a secondary containment) would reduce spillage of drummed materials.
 - E. Bilge wastes, Waste oils and Solvents
 - a. waste oils, solvents and bilge waste should be kept separate in holding tanks and sent to recyclers
 - F. Vessel sanitary systems
 - a. onsite treatment (if practicable) for large volume or continuous stream wastewater.
 - G. Asbestos
 - a. this waste must be kept segregated and managed as hazardous.

Suggestionf for Development and Presentation

Each section in the lesson outline should be example.

References and Resources

Alternate Technologies For the Minimization of Hazardous Waste Report.
California Department of Health Services Toxic Substance Control Program
Alternative Technology Division
July 1990

Suggested Assignments

Have students present a paper comparing the association of the waste reduction options between the metal finishing industry and the marine maintenance and repair industry.

Hazards of Arts and Crafts

Chapter 13

Intent and Approach

This chapter will provide you with an insight to the hazards of the Arts and Craft industry. Most of these industries are small waste generators, however one should be aware of the accumulative aspects of this industry.

Lesson Objectives

To successfully complete this lesson the student will be able to:

1. Describe the operations or categories unique to this industry
2. Recall the waste streams generated by this industry
3. Provide examples of waste minimization techniques used in this industry.

Lesson Outline

1. Operations or categories that are unique to this industry:

- a. Ceramics
- b. Commercial Art and Painting
- c. Dyeing
- d. Fiber Arts
- e. Metal Sculpture/Metal Working
- f. Jewelry
- g. Decoupage
- h. Photography
- i. Print making
- j. Plastic Sculpture
- k. Stained Glass
- l. Stone Sculpture
- m. Welding/Brazing
- n. Woodworking and Furniture Finishing

2. Waste streams generated by this industry

- a. Ceramics - asbestos, heavy metals (lead, barium, manganese, nickel, chromates etc.)
- b. Commercial Art and Painting - Heavy metals in pigments, acrylics, vinyl, resins mercury preservatives, solvents, hexanes, thinners, aromatic hydrocarbons.
- c. Dyeing -benzidine type dyes, acids, alkalis, dichromates, copper sulfate, sodium hydrosulfite
- d. Fiber Arts - Dust molds
- e. Metal Sculpture/Metal Working - metal fumes, silica, nitric acid, sulfuric acid
- f. Jewelry - cadmium solder fumes, asbestos, hydrogen cyanide, mercury
- g. Decoupage - solvent exposure from glues, adhesives varnishes, shellacs, polyurethanes

Environmental Technology

- h. Photography - alkalis acetic acid formaldehyde, sulfur dioxide, dichromates sodium cyanide
 - i. Print making - heavy metals, solvents, acids
 - j. Plastic Sculpture - styrene disocyanates organic peroxides formaldehyde aliphatic amines, solvents, hydrogen cyanide
 - k. Stained Glass - lead, zinc, chloride flux, copper sulfate, selenium dioxide, silver nitrate, hydrofluoric acid.
 - l. Stone Sculpture - silica, asbestos
 - m. Welding/Brazing - Metal fumes, fluoride flux Phosgene
 - n. Woodworking and Furniture Finishing - solvents, wood dust, formaldehyde epoxy resins
3. Examples of waste minimization techniques used in this industry
- a. Ceramics -minimize heavy metal glazes and colorants use with precautionary measures
 - b. Commercial Art and Painting - water based solvents whenever possible, nonaersol solvents, odorless mineral spirits without aromatic hydrocarbons
 - c. Dyeing -vegetable an plant dyes
 - d. Fiber Arts - artificial fibers (rayon, polyester, acrylics)
 - e. Metal Sculpture/Metal Working - sodium hydrogen sulfate for pickling acids
 - f. Jewelry - lead free solders, fluoride free fluxes
 - g. Decoupage - water based glues, adhesives
 - h. Photography - wet chemicals instead of powder mixes, less toxic developers (derivatives)
 - i. Print making - minimize use of benzene, chlorinated solvents.
 - j. Plastic Sculpture - minimize using disocynates, formaldehyde chlorinated solvents, asbestos, hydrogen cyanide go to a single system polyurethane elastomers
 - k. Stained Glass - minimize acids and lead use
 - l. Stone Sculpture - avoid asbestos materials
 - m. Welding/Brazing - minimize use of listed metals minimize fluoride fluxes and chlorinated hydrocarbons
 - n. Woodworking and Furniture Finishing - minimize use of solvents use water based clean up products

Suggestions for Development and Presentation

Each section in the lesson outline should be example. Provide and ask for additional examples for selecting less toxic supplies. Encourage proper handling of material.

Have students provide a paper on disposing options of art materials

References and Resources

Michael McCann Health Hazards for Artists 1985
Monona Rossol "Art Painting ", Center for Occupational Hazards, New York City
U.S. Department of Labor " Hazards of Arts and Crafts" Job Safety and Health Magazine
Department of National Health and Welfare (Canada), The Safer Arts
The Arts and Craft Material Institute INC Boston MA.
Center For Safety In The Arts New York, Ny

Waste From Consumer Related Industries

Chapter 14

Intent and Approach

Products designed for home use are a major source of hazardous materials that find their way into our landfills

This chapter will focus on the generation and disposal of wastes produced by the consumer.

Lesson Objectives

To successfully complete this lesson the student will be able to:

1. Identify sources of hazardous waste generated in the home and office.
2. Describe the potential for environmental damage through either the misuse or improper discharge of household chemicals.
3. Describe alternatives available to the community for proper use and disposal of hazardous household waste

Lesson Outline

1. Discuss the composition and proper use of chemicals in each of the areas of the home.
 - a. Kitchen -detergents, cleaners, whiteners
 - b. Laundry - cleaning agents, stain removers, bleach
 - c. Garage - flammable liquids, combustible liquids, acids, oils, etc.
 - d. Home maintenance - corrosives, polishes, paints, paint removers, solvents, glues, varnishes,
 - e. Outside - pesticides, pool chemicals weed killers, pet care products
 - f. Miscellaneous - Wood preservatives, hobby supplies, batteries,
2. The potential for environmental damage through either the misuse or improper discharge of household chemicals.
 - a. Use of non biodegradable cleaners vs. biodegradable cleaners
 - b. substitution of corrosive/caustic chemicals with less hazardous chemicals
 - c. Access and understand MSDS information or warning labels on containers
 - d. Discharges into POTW 's (do's and don'ts)
 - e Discharges into storm drains (eventually flowing into water tables)
3. Alternatives available to the community for proper use and disposal of hazardous household waste.
 - a. Household waste collection programs
 - b. Community recycling programs
 - c. Following suggested disposal methods on labels or MSDS
 - d. Give leftover paints and supplies to organizations
 - e. Contact local regulatory agency's for disposal suggestions
 - f. Separate "green waste" from disposable garbage.
 - g. Substitute non-toxic for toxic whenever practicable
 - h. Contact a waste exchange provider if available

Suggestions for Development and Presentation

Each section in the lesson outline should be example. Provide and ask for additional examples for selecting less toxic supplies. Encourage proper handling of material.

Have students perform a home/work audit of their stored hazardous materials. Then have the students provide alternatives for the materials and, example exactly how do they intend to dispose of the materials.

Have students identify and example various warning labels associated with their hazardous materials.

Provide students with static display of consumer products, or an Audio Visual presentation on household hazardous waste recognition

References and Resources

Alternatives to Land Filling Household Toxics Golden Empire Health Planning Center 909 12th st suite 203 Sacramento ca.

Making the switch: Alternatives to using Toxic Chemicals in the Home
Golden Empire Health Planning Center Address same as above

Household Hazardous Waste Solving the Disposal Dilemma 1984 Address same as above

The Production, Use and Disposal of Plastics

Chapter 15

Intent and Approach

Discarded plastic products and packaging make up a growing proportion of municipal solid waste. By the year 2000, the amount of plastic we throw away will increase by 50 percent. Current volume estimates for plastic waste range from 14 to 21 percent of the waste stream. By weight plastics contribute seven percent, and less than 1 percent of plastic waste is currently recycled. Additionally, some plastic items end up as litter that poses ecological risk in the marine environment and aesthetic and economic loss. Knowledge of the amounts, types, and uses of plastics produced in the United States is necessary for the evaluation of solutions

Office of Solid Waste, US EPA

Lesson Objectives

To successfully complete this lesson the student will be able to:

1. Understand what the term “plastics” encompasses and their uses
2. Understand how plastics affect the Marine Environment
3. Define degradable plastics and their uses
4. Describe how plastics can be recycled

Lesson Outline

1. The Major Plastics and Their Uses

- A. Five resins account for nearly 60 percent of all plastics used by consumers
 - a. low density polyethylene - used in garbage bags
 - b. polyvinyl chloride - used in cooking oil bottles
 - c. high density polyethylene - used in milk jugs
 - d. polypropylene - used in car battery cases
 - e. polystyrene - used in disposable food containers.
- B. Plastics and landfills
 - a. About 80 percent of all municipal solid waste is landfilled
 - b. 10 percent is incinerated
 - c. virtually all plastics are landfilled or incinerated (because only a small percentage of plastics are recycled)
- C. Disposal Problems Associated With Plastics
 - a. Plastics are slow to degrade (if at all)
 - b. Plastics contain additives and constituents such as:
 - 1) cadmium
 - 2) lead
 - 3) colorants and stabilizers
 - 4) plasticizers
 - c. Plastics contain heavy metal based additives which contribute to the metal content of incinerator ash

2. Plastics in the Marine Environment

- 1. Plastics come from two sources:
 - a. marine based - international waste from vessels, off shore oil and gas platforms, commercial and recreational fishing
 - b. land based - plastic manufactures, sewage treatment plant systems, stormwater runoff, solid waste disposal (barges) and litter
- 2. Problems associated With Plastics in the Marine Environment
 - a. Two major impacts:
 - 1) entanglement - effects seabirds, seals, whales, turtles, fish, and crustaceans
 - 2) ingestion - birds and turtles who mistake plastic for food items

3. Aesthetic and Related Economic Losses

- a. Washed up debris
- b. Odor of decaying marine life washed up on shore
- c. Effects tourism and fishing industry

3. Degradable Plastics

- A. Technologies being Investigated for Consumer Products and Packaging:
 - a. Photodegradation - sun sensitive component that triggers physical disintegration when exposed to sunlight
 - b. Biodegradation - adds a natural polymer (corn starch or vegetable oil) that degrades into smaller pieces of plastic when exposed to the proper environment.

4. Recycling of Plastics

- A. A wide variety of products can be recycled
 - a. bottles are being recycled into fiberfill for coats sleeping bags, pillows, carpeting and other bottles
 - b. Milk jugs are being recycled into toys. flower pots, layers for detergent bottles, and base cups for soft drink bottles
 - c. Polystyrene food containers are being recycled into note pads holders, stackable file holders, pen/pencil holders, and insulation
 - d. A mixture of resins can be made into plastic lumber such as park benches, pallets, docks and fences.

B. Outlook For Plastics

- a. Commitment from manufactures and processors of plastics resins to expand their use of recycled resins along with increased government procurement of recycled plastics will help solidify markets
- b. Individual commitment toward recycling and reduction by substitution would help.

Suggestions for Development and Presentation

Each section in the lesson outline should be example.

References and Resources

EPA Environmental Fact Sheet Plastics : The Facts About Production, USE, And Disposal Office of Solid Waste
February 1990

Methods To Manage and Control Plastic Wastes

EPA Office of Solid Waste/Office of Marine and Estuarine Protection

February 1990

Right to Know Laws

Instructor's Guide

Prepared By:

Ann Boyce
Bakersfield College
1801 Panorama Drive
Bakersfield, CA 93305
(805)395-4552

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Framework: Hazard Communication Standard

Intent and Purpose

In this lesson, the broad framework of federal and California Hazard Communication Standards (HCS) is covered. A foundation is laid using the background and history of the Standards so that students will understand both their purpose and relevance. The impact of this law to affected workers and industries is significant.

The general definitions and terminology used in Hazard Communication are covered with emphasis on use of the definitions in a legal sense; many of the definitions may run counter to a student's day-to-day or intuitive use of the same term.

Differences and similarities between the California and Federal Standards are highlighted by comparison of definitions, scope, and basic requirements.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Explain** why the Hazard Communication Standard was enacted.
2. **List and describe** the five major provisions of the Standard.
3. **Identify** who is regulated and who is protected based on an understanding of the scope of both federal and state Standards.
4. **Describe** the basic differences between state and federal Standards.
5. **Define** general terms listed under "definitions" in the Standard.

Lesson Outline

1. If desired, a “Skills Survey” can be given before actual instruction begins. Selected basic questions about the material to be covered can be compiled by the instructor for this purpose. This can be beneficial because it lets the instructor know the level of understanding by the students *prior* to instruction and it gives the students a better feel for what they will be expected to know *after* instruction.
2. The module should be introduced with an explanation of goals and objectives as well as grading criteria.
3. Historical background of HCS is introduced including:
 - Original 1970 passage of Occupational Safety & Health Act that required employee warning of hazards
 - Difficulty of original substance-by-substance approach
 - NIOSH involvement in recommending standards
 - Final HCS of 11/25/83 limited to manufacturing sector
 - Court challenges
 - Expansion of HCS to include all employers
 - Linkage with Community Right-to-Know Laws that will also be covered in depth in this module
 - Need for a Federally-approved State plan in order for a state to assert jurisdiction
4. Basic provisions and requirements of State and Federal Standards are discussed, including:
 - Scope
 - Hazard Determination
 - MSDS's
 - Labels
 - Written Program
 - Employee Information/Training
 - Trade Secrets
5. The general definitions of the standard(s) are reviewed with emphasis on how they apply to scope & requirements, including:
 - “Article”
 - “Chemical”, “Chemical Name”, “Chemical Manufacturer”

- “Common Name”
- “Container”
- “Designated Representative”
- “Distributor”
- “Emergency”, “Foreseeable Emergency”
- “Employee and Employer”
- “Hazardous Chemical”, “Hazardous Substance”
- “Hazard Warning”
- “Identity”
- “Immediate Use”
- “Impurity”
- “Label”, “Material Safety Data Sheet”
- “Mixture”
- “Produce”
- “Responsible Party”
- “Specific Chemical Identity”
- “Trade Secret”
- “Use”
- “Work Area”, “Workplace”

Suggestions for Development and Presentation

It is important not to go into too much detail until a solid foundation comprised of the purpose, scope, and basic requirements of the standard is developed. The student will achieve greater understanding by initially focusing on the overall framework of the law. The student needs to read and apply the HCS to fully appreciate the grey areas that every regulation possesses. This will be accomplished in the laboratory exercises.

Overhead Transparencies can be effectively used in presenting information on historical background and basic provisions of HCS. Some of the reference and resource materials provided for this lesson can be used to make transparencies. Some examples are the *Standard Industrial Codes* (a sample page) and sections from *California Hazard Communication — A Step-By-Step Approach*.

The discussion of definitions and terminology would be enhanced by the use of slides depicting various images that require thoughtful application of the definitions. Examples are:

- A group of items to determine whether they are “articles”
- Chemical containers labeled with “common names” and /or “chemical names”
- Industrial settings depicting “containers”, “use”, “work area”, etc.
- Different types of labels

References and Resources

Background and History of HCS:

- “Preamble”, *29 CFR* Part 1910
- *29 CFR* Part 1910, Paragraphs a,b (in text)
- “Jennifer Silk Statement”, 1984
- HMTRI, *Course HMT 120*, Pages 1-11 & 1-12
- *CA Labor Code*, Chapter 2.5, Art 1 (in text)
- EDD, *Standard Industrial Classification Handbook*

Basic Requirements of Standard:

- *Steps to Come into Compliance* (OSHA fact sheet)
- *California Hazard Communication; Step-By-Step...*
- “Summary of California’s Hazard Communication Reg”
- *CCR, Title 8*, Section 5194 a,b (in textbook)

General Definitions and Terminology:

- *29 CFR* Part 1910, Paragraph c
- *CCR, Title 8*, Section 5194c (in textbook)
- *CA Labor Code*, Chapter 2.5, Article 2 (in textbook)
- *Hazard Communication Standards & Interpretations*
- ”Director’s List of Hazardous Materials” in Appendix D of *Hazardous Materials Handbook*, CA Chamber of Commerce

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments by Lesson Outline topic number are as follows:

- Topics 3 and 4: Textbook Chapters 1-4
- Topic 5: Textbook Appendix A

Students need to complete these reading assignments prior to Laboratory Exercise #2.

The instructor needs to put together packets of Material Safety Data Sheets for student work groups prior to the first laboratory exercise (they must be passed out then). The students will work in groups that represent supervisory staff at a fictitious business and will utilize the information on the MSDS's over several lab periods. Try to put together a wide assortment MSDS's representing materials that exhibit a variety of physical characteristics and health hazards. Each group can have the same packet but the packets should contain at least a dozen MSDS's.

Lab 1. Health and Safety Hazards

Intent and Purpose

In this laboratory exercise, the physical and chemical characteristics of chemicals will be reviewed in order to assess their capability to present physical and/or health hazards to handlers.

It is assumed that students in this course have taken Chemistry and Health Effects. This laboratory exercise should serve as a review of many of the concepts covered in those courses. Emphasis should be placed on how these concepts apply in the context of disclosure and communication of chemical hazard information. Examples of common workplace materials exhibiting physical and health hazard characteristics are covered.

The legal definitions as stated in the Standard for physical and health hazard characteristics will be reviewed and applied. The student will also explore resources and references providing chemical information.

Students will also evaluate MSDS's to determine whether they provide complete information. This evaluation will utilize information provided in the first lesson.

Laboratory Objectives

To successfully complete this exercise, the student will be able to:

1. **Describe** the health and/or physical hazards associated with various characteristics identified in the "definitions" section of the HCS.
2. **Evaluate** the contents of a MSDS for completeness.
3. **Find** necessary information on specific chemicals using a variety of common references and resources and compare and interpret this data.

1. The following physical hazard definitions are reviewed:

- “Combustible Liquid”
- “Compressed Gas”
- “Explosive”
- “Flammable Aerosol, Liquids, Gases, Solids”
- “Flashpoint”
- “Organic Peroxide”
- “Oxidizer”
- “Physical Hazard”
- “Pyrophoric”
- “Unstable (reactive)”
- “Water-reactive”

2. The following health hazard definitions are reviewed:

- “Asphyxiants”
- “Carcinogens”, “Mutagens”, “Teratogens”
- “Corrosives”, “Irritants”, “Sensitizers”
- “Excursions” (e.g. STEL)
- “Exposure” or “Exposed”
- “Health Hazard”
- “Hepatotoxin”, “Nephrotoxins”, “Neurotoxins”
- “PEL”, “TLV”, “Time-Weighted Average”
- “Reproductive Toxins”, “Toxic Agents”

3. Commonly used references and resources for obtaining chemical information are examined. Examples include:

- ACGIH, *Threshold Limit Values and Biological Exposure Indices*
- NIOSH, *Pocket Guide to Chemical Hazards*

- Sax, Irving, *Dangerous Properties of Industrial Materials*
- Hawley, Gessner, *The Condensed Chemical Dictionary*
- NIOSH, *Registry of Toxic Effects*
- Miscellaneous “Material Safety Data Sheets”

Laboratory Outline

1. Working in small groups, students should evaluate the content of two or three MSDS's to determine whether the elements that they should contain (see Figure 5-4 in Chapter 5 of text) are **adequately** addressed. Sample MSDS's are contained in the attachments for this laboratory exercise. The class should discuss the findings of this exercise before proceeding.
2. Student groups should be told they represent the supervisory staff at a chemical manufacturing/packaging company (let each group come up with a creative name for their “business”). Each group should be given a packet of MSDS's representing the materials their employees work with or may come into contact with at their business. These packets will be used for several of the lab exercises.
3. Student groups should refer to Appendix B in their textbooks to begin evaluating information on the MSDS's in their packet. Specifically, they should develop a short report incorporating a descriptive chart that would clearly provide necessary information and comparisons of the hazards of their materials. This should include, but is not limited to:
 - The order of relative toxicity, from highest to lowest
 - Interpretations of the physical data, such as, those materials that would be expected to float on water, materials that have vapors that would accumulate in low spots, etc.
 - Evaluation of the fire and explosion data
 - Listing of exposure limits and effects of overexposure
 - Interpretation of reactivity data
 - Notation of special precautions
 - Evaluation of necessary protective equipment and procedures

Students should compare the information in the other resources and references that were described in the prelab portion of this exercise to what is available on the MSDS's, where possible. Discrepancies and questionable entries should be made part of their lab report.

Suggestions for Development and Presentation

This laboratory exercise gives the students an opportunity to **review and apply** concepts and terminology they should have covered in previous classes. The discussion after the first MSDS assignment along with the prelab terminology review should be sufficient to get them started in the main group reports required for this period.

Students should be told that the goal of the group lab reports is to **distill and organize** important information from a variety of sources into a report that clearly describes the potential hazards of the materials their employees work with. It should be stressed that their reports must include information tabulated in a chart format. They should be free to explore various formats to best accomplish this. It may help them to explain that this would be the type of information that might be given to top executives that would neither have the time nor inclination to read and attempt to interpret a dozen MSDS's!

References and Resources

Physical Hazard Definitions:

- 29 *CFR*, 1910.1200 (text, Appendix A)
- “Cal/OSHA Hazard Communication Standard”, Section 5194 and Section 6360, et seq., *California Labor Code* (text, Appendix A)

Health Hazard Definitions:

- 29 *CFR*, 1910.1200 (text, Appendix A)
- “Cal/OSHA Hazard Communication Standard”, Section 5194 and Section 6360, et seq., *California Labor Code* (text, Appendix A)

Schedule and Assignments

This laboratory is suggested to take 3 hours of classroom time.

Laboratory reports should be turned in at the beginning of the next laboratory period. This will allow groups that do not complete them in class to finish them outside of class.

Students need to be reminded to keep their packets of MSDS's for future lab sessions.

Lesson 2. Chemical Inventory and Labeling

Intent and Purpose

In this lesson, how to conduct and maintain a chemical inventory and properly label hazardous materials under the HCS is covered.

Students will learn the steps involved in developing a written HCS program including how to prepare a chemical inventory, obtain MSDS sheets, determine if a substance or mixture is hazardous, and how to properly label hazardous materials containers.

Differences and similarities between the California and Federal Standards should again be highlighted during this discussion.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **List** the minimum elements of a written HCS Program.
2. **Describe** important differences between State and Federal Law in scope, applicability, and exemptions.
3. **Explain** the significance of MSDS's and what information they must contain.
4. **Describe** the proper labeling of hazardous materials and mixtures based on the HCS.
5. **Describe** minimum training requirements under the HCS.

Lesson Outline

1. Review the minimum elements of a written HCS Program as stated in textbook as well as **desirable** additions such as a "Company Policy Statement" to show company commitment.
2. The three applications of the HCS that, in 1989, the Office of Management and Budget disapproved under the Paperwork Reduction Act:
 - The requirement that MSDS's be provided on multi-employer worksites
 - Coverage of any consumer product excluded from the definition of "hazardous chemical" under Section 311(e)(3) of the Superfund Amendments and Reauthorization Act of 1986.
 - Coverage of any drugs regulated by the Food and Drug Administration in the non-manufacturing sector.
3. Discuss Sample HCS Program in textbook and contrast it with the sample in the supplemental resources for this lesson.
4. Briefly describe parallel regulatory requirements that will be covered in depth later in this module:
 - California Proposition 65
 - Community Right-to-Know
 - OSHA Hazardous Waste Operations Standard
 - California Injury and Illness Prevention Program
5. Procedure to conduct a complete chemical inventory of all substances and mixtures that pose either a physical hazard or a health hazard.
6. Discuss what responsibilities various departments might have to result in an optimally effective HCS Program.
7. Policies and procedures that will ensure that the chemical inventory is maintained current.
8. Who is responsible for hazard determination?

9. Determination of whether a mixture is a hazardous substance based on whether it contains more than 1% of a hazardous substance or 0.1% of a carcinogen.
10. The necessity of container labeling to provide immediate and reliable information on the contents.
11. Overview of labeling requirements and employer responsibility for developing a flagging system.
12. Minimum requirements for employee training under the HCS.

Suggestions for Development and Presentation

Many of the topics in this lesson can be effectively presented by the use of overhead transparencies. Examples are:

- Minimum elements of written HCS
- Three disapproved applications of HCS
- Parallel regulatory requirements in brief
- Minimum information to be contained on an MSDS

These transparencies can be developed by distilling information in the student textbook and incorporating information from the supplemental resources for this lesson. HMTRI, *Course HMT 120* also has excellent information that can be used for presentation.

Topics that involve procedures can be presented through the use of an industrial scenario to “walk” the student through the actual steps that a particular industry or business would need to take in order to comply. This goal is to prompt discussion of possible options or choices when a “performance standard” is involved.

Actual examples of labels should be used during the discussion of labeling requirements. A variety of labels can be obtained from vendors listed in the textbook on page 32. The NFPA Labeling System should not be dealt with to any great degree in this lesson since it will be covered in depth in other courses. It is sufficient at this point to mention that several labeling systems have been developed that have greater application to other disclosure laws.

References and Resources

Minimum Elements of written HCS Program:

- Cal OSHA *Written Hazard Communication Program*

Sample HCS Programs:

- Fed OSHA *Sample Hazard Communication Program*
- Cal OSHA *Sample Hazard Communication Program*

Parallel Regulatory Requirements:

- Dufour, James T., *Proposition 65 Handbook*, California Chamber of Commerce

Environmental Technology

- Dufour, James T., *Hazardous Materials Handbook*, California Chamber of Commerce (Second text for this module)
- *CFR 29, 1910.120* “OSHA Hazardous Waste Operations Standard”
- Cal/OSHA Consultation Service, *Sample Injury and Illness Prevention Program*
- Cal/OSHA Consultation Service, *Guide to Developing Your Workplace Injury and Illness Prevention Program*

Chemical Inventory:

- HMTRI, *Course HMT 120*, pages 1-22 through 1-27
- Fed OSHA “Hazardous Chemicals List”

Responsibility for Hazard Determination:

- HMTRI, *Course HMT 120*, page 1-28

Minimum Information on MSDS's:

- Fed OSHA *MSDS Bulletin*
- Cal/OSHA *MSDS Bulletin*

Labeling Requirements:

- HMTRI, *Course HMT 120*, page 2-8 through 2-11

Employee Training Requirements:

- Cal/OSHA *Sample HCS Employee Training Program*
- Fed OSHA *Sample Training Program*

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments by Lesson Outline topic number are as follows:

- Topics 1 - 10: Textbook Chapter 5, through page 30
- Topics 11 - 13: Textbook Chapter 5, pages 31 - 36

Students need to complete these reading assignments prior to Laboratory Exercise #3.

Lab 2. Legal Interpretations and Applications

Intent and Purpose

In this laboratory exercise, students will have the opportunity to interpret regulatory requirements for their application in various scenarios. This will be accomplished through student review of case studies.

Students should have read both the California and Federal Standard prior to engaging in this laboratory exercise. Students oftentimes think they fully understand a law until they attempt to apply it to “real life” examples. They can in this way more readily appreciate the “grey areas” involved. Several actual interpretive requests to OSHA coupled with OSHA’s responses are included for the instructor to use to design custom exercises, as desired.

Laboratory Objectives

To successfully complete this exercise, the student will be able to:

1. **Describe** the proper application of legal requirements under OSHA HazCom laws and regulations given hypothetical case studies.
2. **Locate and cite** appropriate sections of the regulations pertaining to legal applications.
3. **Write** a letter to OSHA requesting interpretation of a “grey area” application of the regulations.

Laboratory Outline

1. Students should be reminded of the differences between laws, regulations, guidelines, and standards & interpretations.
2. A copy of an example OSHA policy or guideline statement should be passed out and discussed. Call your local Cal/OSHA office to get one.

Laboratory Exercise

1. Working in small groups, students should discuss each of the following cases and review applicable sections of the law to render a **group** decision, as required. The class as a whole should review and discuss each case before moving on to the next. Each group should be able to fully substantiate their decision with applicable sections of the standard(s).

Does either the California or Federal (or both) Hazard Communication Standard(s) apply in the following cases? Why?

Case 1-- Commercial Stone Co., Inc. is a supplier of crushed limestone in Southwestern Pennsylvania. The company supplies customers from the person with a pickup truck which hauls one or three tons up to large companies that buy 23 ton loads. Commercial Stone Co., Inc. works under the jurisdiction of MSHA while mining and processing this limestone. Must they label and supply MSDS’s to their customers?

Case 2-- Savannah Foods & Industries is concerned. In August of 1985, OSHA published an “Instruction CPL 2-2.38” which included sucrose in the category of a “nuisance dust”, and thereby a hazardous chemical. Upon contact with ACGIH, Savannah Foods & Industries was told that they had no documentation showing that some of the examples of possible nuisance dusts, including sucrose, are hazardous chemicals. There is also the question of “explosivity” of sugar or other dusts. Is Savannah Foods required to provide MSDS’s to the sugar industry they sell to?

Environmental Technology

Case 3-- On November 8, 1985, the Milwaukee Metal Products Company wrote to the President of the United States to voice their concern over the HCS “classifying steel, aluminum, and other metals as ‘Hazardous Chemicals’.” They explain that they are a “job shop which basically shears, punches, and forms these materials: to customer specifications. Are they required to send MSDS’s to the customer with each order?

Case 4-- Toxicologists Steven Malish, Ph.D. noted that an article in “Plastics Technology” indicated that for purposes of the HCS, if a mixture contains as little as 0.1% of a carcinogen or 1% of any other hazardous substance, the entire formulation must be treated as a hazardous chemical. He explains that many plastic formulations contain carcinogens or other hazardous substances at levels greater than 0.1%; examples are lead stabilizers and antimony flame retardants. His company uses purchased plastic pellets to fabricate wire insulation. Their product is the wire. He further explains that “during the fabrication process, virtually no exposure to these substances occurs as evidenced by ambient air monitoring and wipe samples, and all air concentrations for these substances are kept substantially below the current TLV and PEL.” Does this company’s product, various types of cable consisting of various types of plastic insulation covering a metal or glass core, need a material safety data sheet under the regulation?

2. After each case is discussed by the class, the instructor should share the interpretation of OSHA to help the student understand the appropriate application of the law. By looking at these cases, the student should have a clearer understanding both of the law and the type of analytical skills that are required to adequately read and interpret it. See the following “Suggestions for Development and Presentation” for a discussion of OSHA’s interpretation in each of these cases.
3. In a somewhat reverse aspect of this exercise, each student should find a section of the law that interests him/her and think carefully about a situation that possibly falls into its “grey area.” Once thought through, the student should carefully prepare a letter to OSHA requesting an interpretation. This is **not** a group exercise. Each student should prepare his or her own letter. Explain that selection of the hypothetical situation is important for successful completion of this assignment.

The following is a discussion of each of the cases described in the laboratory exercise:

Case 1-- This interpretive request to OSHA was dated 3/3/86. At that time, OSHA stated in their response that “establishments engaged in quarrying and crushing operations would be included in SIC code 1422 and are not included in the present scope of the hazard communication standard.” A class discussion should revolve around whether this type of operation is **currently** covered. This will also reinforce the impact of expansion of the scope of the HCS and the necessity to keep abreast of changes in regulations. Students must also research the regulations to determine whether crushed limestone is a “hazardous chemical.” A copy of OSHA’s letter of response is in the attachments for this laboratory exercise (Record No.: 2523).

Case 2-- This case poses some interesting questions about nuisance particulates. A copy of OSHA’s letter of response is in the attachments for this laboratory exercise (Record No.: 2509).

Case 3-- This case presents the interesting interpretation that “as part of the evaluation (hazard determination) the manufacturer must anticipate the uses to which product will normally be put.” A copy of OSHA’s letter of response is in the attachments for this laboratory exercise (Record No.: 2541).

Case 4-- This case involves a difficult interpretation of the term “article.” This case should elicit interesting discussion. A copy of OSHA’s letter of response is in the attachments for this laboratory exercise (Record No.: 1206).

Suggestions for Development and Presentation

These are but a small sample of interpretative documents that can be obtained from OSHA. It would be beneficial for the instructor to consult with the nearest Cal/OSHA office to acquire similar, more recent documents.

References and Resources

Interpretations:

- Occupational Safety and Health Administration, *Hazard Communication Standard--Interpretations, Indexes, and Letters*, June 1986

HCS Regulations:

- 29 *CFR*, 1910.1200 (text, Appendix A)
- Cal/OSHA Hazard Communication Standard, Section 5194 and Section 6360, et seq., *California Labor Code* (text, Appendix A)

Schedule and Assignments

This laboratory is suggested to take 3 hours of classroom time. There may be some time to cover topics from previous sessions that were not completed due to time constraints.

Individual assignments (requests for interpretation) should be turned in at the beginning of the next laboratory period. This will allow students that do not complete them in class to finish them outside of class. It may be interesting for the instructor to consult with OSHA representatives on a couple of the more interesting questions submitted for further class discussion.

Students should be reminded that they will need to use their packets of MSDS's at the next lab session.

Student reading/study assignments by Lesson Outline topic number are as follows:

- Topic 1: MSDS Glossary (see attachments)
- Topic 2: Textbook Chapter 6
- Topics 3 - 6: Instructor handouts developed from Lesson 5 of HMTRI, *Course HMT 120*, OSHA attachments provided, and other current sources on learning theory.
- Topic 7: Textbook Chapter 7
- Topic 8: Textbook Chapter 8 and Appendix C
- Topic 9: Cal/OSHA, *Guide to Developing Your Workplace Injury and Illness Prevention Program*; appropriate excerpts from *CCR Title 8, Part 3202*

Lesson 3. Training and Other Employer Responsibilities

Intent and Purpose

In this lesson the student will learn effective means of conducting employee training in the various Hazard Communication elements.

Students will be introduced to terminology and definitions that will round out the concepts covered in Exercise #1. These terms are widely used in the development of MSDS's and range from acronyms for testing and standards development entities to governmental regulatory agencies to additional chemical characteristics related to physical and health hazards.

A large part of the HCS is ongoing employee training. This lesson will give the student information on methods to conduct training that would enable him or her to assist in this function. This information will be applied in the final laboratory exercise for this module.

The duties of manufacturer's and suppliers as well as employers will also be covered. Major topics to be covered include trade secret protection and access to employee exposure and medical records.

The California Injury and Illness Prevention Program will be looked at again for a perspective on how it can be viewed as an "umbrella program" to tie together HazCom, Hazwoper, and Emergency Planning and Community Right-to-Know programs.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Define** commonly used MSDS terminology and acronyms.
2. **List** the four major objectives of a HCS training program.
3. **Explain** what "learning" is.
4. **Identify** four important considerations in assessing training need(s).
5. **Explain** how trade secret protection may alter manufacturer's and supplier's duties.
6. **Describe** what "access to exposure and medical records" means.
7. **Analyze** how the various training, awareness, and disclosure laws can be integrated into one comprehensive safety program.

Lesson Outline

1. The definitions of common terminology used on MSDS's, and not covered in Laboratory Exercise #1 are reviewed, including:
 - "Acid", "Alkali", "Base", "pH"

- “Benign”, “Malignant”, “Carcinoma”, “Neoplasia”, “NTP”, “NCI”
 - “Pulmonary Edema”, “Chemical Pneumonitis”
 - “Dyspnea”, “Malaise”, “Anesthetic”, “Narcosis”
 - “Grounding”, “Bonding”
 - “Hematopoietic System”, “Hematoma”, “Hematuria”
 - “Lacrimation”, “Jaundice”
2. Discuss the four minimum requirements of a HCS training program listed on page 37 of the student text in terms of the four learning objectives that are described on page 5-12 of HMTRI, *Course HMT 120*.
 3. Provide brief overview of current learning theory including “teaching” versus “learning”.
 4. Review process for identifying training needs and how these needs impact the development of a training program. Include information on obtaining audiovisual and publications aids from OSHA to assist in training.
 5. Discuss the importance of writing performance objectives for training.
 6. Cover requirements for training documentation.
 7. Explain the concept of “trade secret protection”.
 8. Discuss the rights of employees to medical and exposure records.
 9. Pass out and review Cal/OSHA’s *Guide to Developing Your Workplace Injury and Illness Prevention Program*.

Suggestions for Development and Presentation

The instructor should not spend too much time on the terminology portion of this lesson. Students should have had exposure to the majority of these terms in previous classes, especially “Health Effects of Hazardous Materials.”

The majority of class time for this lesson should be devoted to a discussion of learning theory. These concepts will be a fairly new to the HazMat student since no other course includes them. Effective and continuous training in the industrial setting, however, is being emphasized more and more both from a legal and risk-reduction standpoint. EHMT graduates will be in a good position to assist with this training and, therefore, need to understand basic principles of learning.

Let students know that they will be able to put this information to use in the final laboratory session where they will be expected to put together a training program and do a short, 5-7 minute presentation from it.

The continued discussion of California’s Injury and Illness Prevention Program is of particular importance. It is recommended that the “final project” be the individual development of this type of comprehensive “umbrella plan” that incorporates all of the elements in this module. This will serve to bring together all of the concepts that have been covered and further the student’s ability to **apply** them in a meaningful manner.

Environmental Technology

If the instructor chooses to require this plan for a final project, the requirements and expectations should be covered in this session. The student can then prepare for this end result as he/she completes other labs in this module.

References and Resources

Terminology:

- *MSDS Glossary*, developed by Fed OSHA

Training:

- OSHA, *Audiovisual and Publications Products*
- OSHA, *Voluntary Training Guidelines*
- OSHA, *Grantee Products and References* lists
- OSHA, *Regional and Area Offices and Hazard Communication Coordinators*
- OSHA, *State Consultation Project Directory*
- HMTRI, *Course HMT 120*, Lesson 5

Exposure and Medical Records:

- OSHA, *Access to Employee Exposure and Medical Records*

Injury and Illness Prevention Program:

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments by Lesson Outline topic number are as follows:

- Topic 1: MSDS Glossary (see attachments)
- Topic 2: Textbook Chapter 6
- Topics 3 - 6: Instructor handouts developed from Lesson 5 of HMTRI, *Course HMT 120*, OSHA attachments provided, and other current sources on learning theory.
- Topic 7: Textbook Chapter 7
- Topic 8: Textbook Chapter 8 and Appendix C
- Topic 9: Cal/OSHA, *Guide to Developing Your Workplace Injury and Illness Prevention Program*; appropriate excerpts from *CCR Title 8, Part 3202*

Lab 3. Preparing a Written Hazard Communication Program

Intent and Purpose

In this laboratory exercise, students will work in groups to develop a written Hazard Communication Program for their hypothetical “businesses.” They will utilize the MSDS packets provided in the first laboratory session as well as the typical references and resources that were introduced.

Laboratory Objectives

To successfully complete this exercise, the student will be able to:

1. **Develop** a written Hazard Communication Program making sure all legal requirements have been met.
2. **Clearly write** a comprehensive Hazard Communication Program for a hypothetical business.

Laboratory Outline

1. Students should be told that although they have MSDS’s, they do not have enough information to immediately start writing their Hazard Communication Program. They will need to more fully develop a business “scenario”.

To do this, they should do some research (using any available references and resources) to decide **how** and **why** they are handling the chemicals they have. This will give them a more realistic way to determine amounts in their inventory and also to discover that they may be missing MSDS’s for some of the raw materials that might be involved in the process (or packaging).

2. It should also be emphasized that this is a major project and that, as is the case in the “real world”, one person does not do it all. Groups should logically divide up the work by, for instance, assigning one person to be “plant manager” (responsible for the inventorying of materials used), one person might be “foreman” (responsible for personnel duties and activities), one person might be “purchasing agent” (responsible for compiling and acquiring MSDS’s), etc. Let the students decide how best to accomplish a mutual goal.
3. Explain that the resultant product will not be a two page “form” program such as that shown as Figure 5-2 in their textbooks. They will derive the greatest benefit from this exercise by developing a comprehensive and somewhat detailed document.

Laboratory Exercise

1. Working in small groups of no more than 3-4, students are to develop a business scenario that involves the use of, at a minimum, the chemicals provided in their MSDS packets.
2. Once a suitable business scenario has been developed, student groups are to develop and write a comprehensive Hazard Communication Program. For those chemicals that are used which have no MSDS available, a letter requesting the MSDS is to be included as part of the written program. All groups must have at least one request in their document.

Suggestions for Development and Presentation

This laboratory exercise gives the students an opportunity to **review and apply** what they have learned in previous lessons and labs. The instructor should spend very little time in explanation, thereby giving students the bulk of the period to work on their project and ask specific questions as needed.

Environmental Technology

It may be helpful for the students to explain their “hypothetical business scenario” to the instructor before going on to the written portion of the assignment. This will satisfy the instructor that they have carefully thought through all aspects of their operation and are ready to proceed.

References and Resources

There are no new references and resources for this exercise.

Schedule and Assignments

This laboratory is suggested to take 3 hours of classroom time.

Laboratory reports should be turned in at the beginning of laboratory session #5. This will allow groups to work on this project for a part of the next laboratory session as well as outside of class

Lesson 4. Framework: Community Right-to-Know

Intent and Purpose

In this lesson, the broad framework of federal and California Hazardous Material Disclosure laws are covered. A basic understanding of the intent of the laws will be emphasized enabling students to understand how disclosure laws satisfy Right-to-Know legislation.

The general provisions of California’s disclosure laws will be examined in detail since they parallel federal disclosure standards and in most cases are stricter than the federal government.

Students will learn to distinguish which businesses must submit disclosure forms and also what exemptions are in place for certain products and industries.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Explain** the origins and purpose of Community Right-to-Know legislation and how it relates to business and the public.
2. **List and describe** the elements of the Hazardous Material Business Plan requirements.
3. **Identify** under what circumstances a business must comply with the Right-to-Know requirements.
4. **Determine** when certain exemptions can be utilized for certain industries and products.
5. **Describe** the differences and the areas of overlap between the federal and California’s Right-to-Know programs.

Lesson Outline

1. Historical Background of Right-to-Know:
 - Public concern over chemical incidents

- Dec. 1984 - Bhopal, India
- Sept. 1985 - AB 2185
- July 1986 - AB 2187 “clean-up bill”
- Sept. 1986 - AB 3777 Acutely Hazardous Materials
- Oct. 1986 - SARA Title III
- 1988 - AB 2189 combines state and federal.

2. Elements of the Business Plan:

- Chemical inventory in excess of certain amounts
- 55 gallons liquid, 500 lbs. solid, 200 ft³ gas.
- Emergency Notification and Response Plans
- Evacuation procedures
- Hazard Communication Training for Employees
- Release Reporting Procedures

3. What Business Must Comply:

- Any business that handles a hazardous material
- Some exemptions may apply in jurisdictions

4. What Exemptions May Apply:

- Businesses handling less than 55 gal., 500 lbs., 200 cu. ft.
- Products packages solely for consumers
- Materials found not to present a hazard
- Materials not stored in excess of 30 days
- Ag businesses exempt from Emergency Response Plans

5. Differences in the State and Federal Right-to-Know:

- Organizational Structure and Authority
- Chemical Inventory Requirements
- Inventory Reporting

- Risk Management
- Submission of Response Plans
- Enforcement

Suggestions for Development and Presentation

The student should initially understand the intent of the regulations and become aware that California and the EPA were working independently of each other at accomplishing essentially the same goals. It should be emphasized that the two programs were effectively merged in California during 1988 by AB 2189.

A slide presentation is an ideal way to overview the events leading up to and the basic provisions of the Right-to-Know laws. The Local Emergency Planning Committee and fire departments in the area are a good source of audio-visual aids for scenes depicting chemical incidents.

Overhead transparencies should be used to demonstrate more detailed comparisons of the state and federal programs. Details, when used constructively, should reinforce the general concepts introduced in the beginning of the lesson.

References and Resources

Background and History:

- Forward and Introduction, “Community Right-to-Know: The Guide to SARA Title III”
- “Legislative Findings and Declaration,” Section 25500 of Chapter 6.95 of the *California Health and Safety Code*.

Basic Requirements of the Business Plan:

- Chapter 6.95 of the *California Health and Safety Code* (Appendix B in text).
- Instructions from local implementing agency on how to file, etc.
- Title 19, *California Code of Regulations* (Appendix C in text)

Comparison of the State and Federal Requirements:

- *Hazardous Materials Emergency Planning and Community Right-to-Know*, (OES).
- “SARA Title III” (Appendix A in text)

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments by Lesson Outline topic number are as follows:

- Topic 1: Textbook Chapters 1-3
- Topic 2: Textbook Chapter 4, Textbook Appendix B

- Topic 3: Textbook Chapter 5
- Topic 4: Textbook Chapter 6
- Topic 5: Textbook Appendix A and *Hazardous Material Emergency Planning and Community Right-To-Know* (OES publication).

Lab 4. Determining a Hazardous Materials Handler

Intent and Purpose

In this laboratory exercise, the physical and chemical characteristics that determine if a substance will be considered a hazardous material are examined.

Students will review the regulatory criteria that legally define a material as hazardous. Special emphasis will be placed on individual administering agencies having the authority to adopt standards stricter than the regulations.

In the absence of stricter local ordinances, certain exemptions are allowable under state and federal reporting laws. These turnkey exemptions for some products and industries will be reviewed and applied. By the end of the laboratory, students will have a broad understanding of what hazardous materials regulations consider a “handler”.

Laboratory Objectives

To successfully complete this exercise, the student will be able to:

1. **Determine** if a substance is defined as hazardous by an administering agency.
2. **Identify** the criteria which defines a product or substance as hazardous.
3. **List** the reportable quantities of a hazardous material for the three physical states of matter (i.e. solid, liquid, gas).
4. **Describe** the exemptions in place for certain quantity, products, and industries regarding the Hazardous Materials Release Response Plans and Inventory.

1. Review how to determine if a substance is hazardous:

- Material Safety Data Sheet (MSDS)
- Title 49, *Code of Federal Regulations*
- Section 6382 of the *California Labor Code*

2. Criteria defining a hazardous material handler:

- Section 25501(j) Ch. 6.95 Cal H & S Code
- “Reasonable basis” for Administering Agency

Environmental Technology

- Definition of “Handle” Sec. 25501(h)

3. Reportable Quantities of a Hazardous Material:

- 500 pounds or more of a solid
- 200 cubic feet or more (at standard temperature and pressure) of a compressed gas
- 55 gallons or more of a liquid

4. Exemptions for Certain Materials and Handlers:

- Packaged for distributions consumer products
- Product or handler poses no significant present or potential hazard to human health, safety, or the environment
- Farm businesses not required to submit emergency response portion of business plan if annual inventory is submitted and hazardous materials storage is properly labeled

Laboratory Exercise

1. Students should work in the same small groups that are developing a Hazard Communication Program. These groups should review their business scenario and chemicals used for lab exercise #3 (remember to use MSDS's) to determine whether they have materials that would **also** require a Hazardous Materials Release Response Plan and Inventory.
2. Each group should prepare a chart with all chemicals in use at their hypothetical business and explain for each whether or not it is covered under the Hazardous Materials Release Response Plans and Inventory requirements. The appropriate section(s) in the regulations must be cited for each exemption or inclusion.
3. Students should be given at least an hour of this period to continue work on their written Hazard Communication Programs. These are due at the beginning of the next lab session.

Suggestions for Development and Presentation

A prelab lecture will prepare the students to use the materials needed to complete the laboratory exercise. Overhead transparencies should be used to review the information included on the Prelab Outline.

Interesting case studies and hypotheoretical scenarios can be used to stimulate class discussions and reinforce the concepts just introduced. It is important, however, to spend no more than approximately one hour on the pre-lab (including guest speaker, if there is one). Students need the time to start applying the many important aspects of the law that they have learned so far.

A guest speaker from a local Administering Agency can assist with discussion of the rationale and procedures for the hazardous materials exemption process. Likewise, if the local AA has stricter requirements than the state or federal law, these can be explained as well.

References and Resources

- Chapter 6.95 *California Health and Safety Code*, Sections 25501, 25503.5
- Title 49, *Code of Federal Regulations*
- Section 6382 of the *California Labor Code*
- Material Safety Data Sheet

Schedule and Assignments

This laboratory is suggested to take 3 hours of classroom time.

The laboratory report for this session (chemical chart with determinations of whether Release Response Plans and Inventory apply) is due at the beginning of the next laboratory period.

Completed Hazard Communication Programs are also due at the beginning of the next laboratory session.

Lesson 5. Releases and Reporting Requirements

Intent and Purpose

In this lesson, students will learn how to properly notify administering agencies for the Hazardous Materials Release Response Plans and Inventory Law.

The general methods of determining when a release or threatened release is reportable will be examined. Students will learn to distinguish the reportable quantities for each extremely hazardous material and toxic chemical release.

Students will be instructed on what agencies must be contacted for spill notification. Fines and penalties for failure to report releases will also be emphasized.

Lesson Objectives

To successfully complete the lesson, the student will be able to:

1. **Determine** the reportable quantity of each extremely hazardous material in the event of a release or threatened release.
2. **Identify** the reporting requirements and agencies requiring notification of chemical incidents.
3. **Recognize** circumstances when chemical spills are immediately reportable or when delays in reporting are necessary.
4. **Complete** a Toxic Chemical Release Form and an Emergency Release Followup Notice Reporting Form.
5. **Describe** the fines and bounties involved with failure to report a release or threatened release of a toxic or extremely hazardous chemical.

Lesson Outline

1. To determine the reportable quantity of an acutely hazardous material:

Environmental Technology

- Find the material listed alphabetically or by CAS Number in the List of Extremely Hazardous Materials.
- Read across to the Reportable Quantity Value (in pounds) for the product.

2. Emergency and Agency Notification Procedures:

- 9-1-1
- Administering Agency
- Office of Emergency Services
- National Response Center
- Report must Include:
 - Exact location
 - Name of person
 - Material involved
 - Estimate of Quantity
 - Potential hazards involved

3. Immediate Reporting of Releases

Definitions:

- “Release”
- “Threatened Release”

Immediate verbal report to:

- Administering Agency
- Office of Emergency Services

As soon as:

- Knowledge of situation
- Immediate control of situation attempted
- Immediate medical attention given

4. Complete a Toxic Chemical Release Form:

- Section 304 SARA Title III Form

- California Hazardous Materials Incident Report (CHMIR)

5. Fines for failure to report:

First offense:

- \$25,000 per day of violation
- One year imprisonment

Subsequent Convictions:

- \$50,000 per day of violation
- Two years imprisonment

Suggestions for Development and Presentation

Students should be shown how to reference the “List of Extremely Hazardous Substances” by chemical name or by CAS#. This can be done using an overhead projection of a page from the list of EHS’s. A predetermined quantity of a chemical released can be compared to the “Reportable Quantity” shown on the list. If the chemical released exceeds the RQ then the release must be reported under federal law.

It should be emphasized that California has adopted the following “Reportable Quantities” of 42 gallons, 200 cubic feet, 500 pounds, or the federal RQ, whichever is less.

Some case studies or guest speakers could provide some actual scenarios where spills that went unreported caused considerable damage. Or conversely, spills reported in time allowed for proper emergency response and mitigation of the hazard.

References and Resources

Determining Reportable Quantities:

- *Appendix A (in textbook)
- *Appendix B (in textbook)

Followup Notices:

- *Appendix C (in textbook)

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments by Lesson Outline topic number are as follows:

- Topics 1-5: Textbook Chapter 7 and Appendix C

Lab 5. Developing the Business Plan

Intent and Purpose

In this laboratory exercise, students will complete a hazardous materials “Business Plan”. This exercise will be the application of skills learned from laboratory exercise 4 on how to determine a hazardous materials handler.

The student will learn how to complete all the necessary forms for either a standard or agricultural business. Update and revision schedules shall also be determined. To provide the student with a national scope of inventory reporting, a SARA Title III Tier II inventory form will also be completed in addition to the California Form.

All the elements of the Emergency Response Plan and Chemical Inventory shall be covered to equip the student with a working knowledge of the requirements involved.

Laboratory Objectives

To successfully complete this lesson, the student will be able to:

1. **Determine** the appropriate local administering agency for the submission of the Business Plan in any given locality.
2. **Identify** the circumstances when a revised chemical inventory and/or Business Plan must be re-submitted.
3. **Complete** a chemical inventory on both the California and SARA type forms.
4. **Complete** the Emergency Response Plan and Procedures appropriate for any given type of business.
5. **Outline** a Hazardous Materials Training Program for Employees based on the Hazard Communication Standards (HCS).

Laboratory Outline

1. Determine the appropriate Administering Agency:

- LEPC (outside California)
- County Health/Fire Dept./OES
- City Hall/Fire Department

2. Updates and revisions of the Business Plan:

Within 30 days of these events:

- 100% increase in previously disclosed material.
- Handling a reportable quantity of any new hazardous material.
- Change in business ownership, address, or name of company.

Annual update of inventory required

Certification of entire plan every 2 years

3. Complete the California and SARA Chemical Inventory:

- Explanation of required information
- Review of entry codes

4. Complete the Emergency Response Plan and Procedures:

Review instructions for Business Plan:

- Business Identification Data
- Emergency Notifications
- Location of Utility Shutoffs
- Private Response Team
- Local Emergency Medical Assistance
- Employee Training
- Prevention, Mitigation and Cleanup Procedures
- Notification & Evacuation Procedures
- Private Fire Protection Systems
- Available Water Supplies
- Site map

5. Training Program for Employees:

- Methods for safe handling of hazardous materials.
- Cal OSHA Hazard Communication Standard linkage
- Use of emergency response equipment and supplies.
- Knowledge of the Emergency Response Plan Procedures.

Suggestions for Development and Presentation

The Pre-lab lecture for this exercise will provide the detailed explanation required to complete the “hands-on” portion of the laboratory. Students can then refine their skills as they complete an actual Hazardous Materials Business Plan.

Environmental Technology

Students can either be provided with a one-page scenario describing a fictitious company requiring a Business Plan or, preferably, use the scenarios they developed for their HCS. If the latter is done, the same small groups will complete the exercise. Instructors may want to adapt or modify the laboratory exercise to include more representative scenarios of businesses located within their communities. If so, the scenarios should provide enough information for the student to complete the required information. However, the scenarios shall not be so complete as to preclude the student's own inference relating to appropriate response and planning.

Instructions and forms for developing a business plan in Kern County are included in the attachments. These can be used but it would be preferable to use information packets of this sort from the appropriate local agency in the area where the course is being given.

Students should be told not to spend a lot of time on the training aspect of this exercise. They should merely outline the basic requirements for training, linking HCS and Business Plan requirements. They will get the opportunity to explore this part of the requirement more fully in the next laboratory exercise.

References and Resources

Other than acquiring a "Business Plan Information Packet" similar to the Kern County version attached, there are no additional references and resources for this exercise.

Schedule and Assignments

This laboratory is suggested to take 3 hours of classroom time. Laboratory reports should be turned in at the beginning of lab session #7. Reading assignments are as follows:

- Textbook Chapters 8-10
- Local forms and information compiled by instructor

Lesson 6. Handling Acutely Hazardous Materials

Intent and Purpose

In this lesson, the additional requirements for businesses that handle acutely hazardous materials will be covered. The supplemental laws are intended to reduce the risk of accidental releases of extremely hazardous substances.

Emphasis will be placed on the essential elements required for developing a Risk Management and Prevention Program (RMPP). Students will also become familiar with the list of Acutely Hazardous Materials (AHM's) and the quantities handled which necessitate completion of a RMPP.

Students will be introduced to the concepts of chemical risk communication and risk perception by the public. Industry response to chemical risk perception will be examined through the Community Awareness and Emergency Response (CAER) program.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Develop** familiarity with the list of Extremely Hazardous Substances and be able to determine if a chemical is considered an Acutely Hazardous Material (AHM).

2. **Understand** the difference between the California and federal Threshold Planning Quantities (TPQ) for AHM's.
3. **List** the essential elements required to prepare a Risk Management and Prevention Plan (RMPP).
4. **Explain** the basic guidelines and considerations about communicating risks to the public.
5. **Describe** the origins and goals of the Community Awareness and Emergency Response (CAER) Program.

Lesson Outline

1. Students will become familiar with Extremely Hazardous Chemical lists by referencing several substances which may or may not be contained therein.
2. Differences in California's inventory quantity compared with the Federal Threshold Planning Quantity:

Businesses must inventory the substance if amount is equal to or greater than:

California:

- 55 gal, 500 lb, 200 ft³
- At least 1% by weight AHM

Or-

Federal:

- Multiply % of weight of AHM in lbs. by weight of total mixture and compare with TPQ in SARA list.
- Subject to two TPQ's lower quantity for:

Solutions
Molten form
<100 micron particle size
10,000 lb. default TPQ

> = 1% AHM in 55 gal, 500 lb, 200 ft³ OR >TPQ, Whichever Is Less!!

3. List and describe the purpose and elements of a Risk Management and Prevention Program:

Purpose:

- Describe existing conditions
- Analyze possible hazards
- Determine steps to reduce risks

Elements:

- Description of past accidents
- Age and condition of equipment
- Design and operating controls
- Detection and monitoring equipment
- Record keeping and inspection
- Employee training and responsibilities
- Identify hazards present
- Likely off-site consequences

Objective:

Implement steps to reduce risk:

- Modify existing operations
- Add or repair equipment
- Increase training and recordkeeping

4. Guidelines for risk Communication:

- Make the data relevant
- Be careful with regulatory terms
- Accept and involve the public
- Listen to your audience
- Be honest and compassionate
- Coordinate with credible sources
- Satisfy needs of the news media

5. Origins and goals of Community Awareness and Emergency Response (CAER) Program:

- Established in 1985 by Chemical Manufacturers Association.
- Improve local emergency response planning
- Provide public information on chemicals
- Offer recognition awards and incentives

Suggestions for Development and Presentation

The general intent of risk analysis and communication should be emphasized. Many elements of handling Acutely Hazardous Materials are still relatively new and controversial. Care should be taken not to get lost on details other than how to determine the Threshold Planning Quantities (TPQ).

Case studies and student presentations should be used to develop skills in communicating chemical risks. A guest lecturer from the media would provide some insight on his/her experiences with what the public wants to know. Also, representatives from a local CAER group can explain first-hand the purpose of Community Awareness and Emergency Response.

References and Resources

Acutely Hazardous Materials:

- Notification Form (Appendix F in text)
- List of Acutely Hazardous Substances

Risk Management and Prevention Program:

- Article 2, Ch. 6.95 *California Health and Safety Code* (Appendix B in text)
- “Guidance for Risk Management and Prevention Program” Kern County Fire Dept.
- “Risk Management and Prevention Programs Under LaFollette Bill AB 3777/1059” Hazmacon 89
- AB 2132, Floyd and AB 3205, Waters

Chemical Risk and Community Awareness:

- *Chemical Risk Communication*, American Chemical Society
- *Community Awareness and Emergency Response Program* Policy Guide
- *Industry: Turning a Problem Into a Solution*, Fire Engineering, August 1989 pp 78-82

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments by Lesson Outline topic number are as follows:

- Topic 1: Textbook Appendix F (1)
- Topic 2: Textbook Appendix F (2)
- Topic 3: Article 2, Ch. 6.9 (Textbook Appendix B, pp. 81-88)
- Topic 4: *Chemical Risk Communication*, American Chemical Society (Handout)
- Topic 5: Textbook Chapter 13 and CAER Handouts

Lab 6. Emergency Release Notification

Intent and Purpose

In this laboratory exercise, the methods and requirements for inventorying Extremely Hazardous Substances (EHS) will be examined. The same skills learned for inventorying EHS will also be applied to determine the Reportable Quantity (RQ) of an EHS when it is released or threatened to be released into the workplace or environment.

At one point the students will calculate the EHS component in pounds based on the percent by weight of EHS in the product mixture. This should not prove to be too difficult once the objective is clear.

It should be emphasized that the fundamental differences between the Federal EHS and California's AHM are the calculators required for inventory and spill reporting notification requirements.

Laboratory Objectives

To successfully complete this exercise, the student will be able to:

1. **Determine** if a product is listed as an Extremely Hazardous Substance (EHS). In California Extremely Hazardous Materials are called Acutely Hazardous Materials (AHM).
2. **Calculate** the Threshold Planning Quantity (TPQ) for any Extremely Hazardous Material, and in California, for Acutely Hazardous Materials.
3. **Identify** the Reporting Quantity (RQ) for any Extremely Hazardous Material involved in a release or threatened release. In California, identify the reporting quantity for any Acutely Hazardous Material release or threatened release.
4. **List** the required information to adequately report a release or incident involving any EHS to the State Emergency Response Commission. In California, the reporting of an incident involving AHM's should include the Office of Emergency Services as well as the local Administering Agency or 9-1-1.
5. **Prepare** a written followup notice updating the agencies notified of the incident.

Pre-Lab Outline

1. A list of various substances is given in order for students to identify which of those are actually on the List of Extremely Hazardous Substances. The list will contain products listed by either chemical name or Chemical Abstract Service (CAS) Number.
2. Using Material Safety Data Sheets (MSDS), the percent by weight of an EHS will be referenced to determine TPQ (in pounds) for various amounts of products containing mixtures of EHS.

In California products containing 1% or more of an AHM in the mixture have the following TPQ:

- 55 gallons (liquid)
- 200 cubic feet (gas)

- 500 Pounds (solid)
3. Using the same technique of multiplying % by weight of the EHS times the total weight of the mixture, find the Reportable Quantity (RQ) in the event of a release or threatened release of the product.
 4. Required information to report in the event of a release or threatened release of an EHS:
 - Chemical name of substance
 - Whether EHS or not
 - Quantity of material involved
 - Time and duration of release
 - Medium into which the release occurred
 - Any known health risks
 - Necessary precautions to take
 - Names and phone numbers of persons to be contacted for further information.
 5. Requirements for the written followup notice:
 - All of the items required in Objective #4 (above)
 - Actions taken to respond and contain the release.
 - Any known or anticipated health risk.
 - Medical advice for exposed individuals.

Laboratory Exercise

1. The prelab discussion and demonstration is designed to take the student through reporting requirements and calculations. Students should be given the opportunity to practice determining whether they have a TPQ of EHS's, particularly in mixtures.
2. During the second half of the lab session, student groups should work on a comprehensive training program for the employees of their fictitious businesses. These training programs should be designed to meet training requirements both of the HCS and Community Right-to-Know laws. These written training programs are due during the next lab session.
3. Each student should prepare to present a 5 minute training segment out of their group's training program during the next and final lab period. This is where the concepts of learning theory and training that were covered in lesson 3 will be applied.

Suggestions for Development and Presentation

The first part of this lab is designed to familiarize students with the additional requirements for inventory planning quantities and spill reporting of Extremely Hazardous Substances. It should be noted that in California, EHS's are also known as Acutely Hazardous Materials. Although the lists of chemicals is the same whether they're called EHS's or AHM's, California handles the quantities differently for AHM reporting.

It must be emphasized that in California, any spill over 55 gallons must be reported. If AHM are involved, the Reportable Quantity becomes the RQ for an EHS if it can be calculated to be less than 55 gallons. So in California, if the RQ does not equate to less than a 55 gallon amount, the RQ defaults to 55 gallons, 200 cubic feet, or 500 pounds anyway.

The second part of this lab (approximately 1.5 hours) should bring student work groups together for the final task of developing a training program that will fulfill Business Plan and HCS requirements. During the last session, they should have worked on an outline of requirements. They should now expand that outline to a full written program.

While developing the training program, students should be thinking about a 5 minute presentation that would represent some aspect of required training that they might **actually use to train their employees**. Five minutes is a short amount of time so it is important that they cover only one or two concepts in that time. Explain that they should keep in mind how people would best learn what they are trying to teach. Creativity and originality count!

References and Resources

There are no additional references and resources for this laboratory exercise.

Schedule and Assignments

This laboratory is suggested to take 3 hours of classroom time.

Written training programs developed by each group are due at the next laboratory period.

Students must be prepared to make 5-7 minute training presentations to the class at the next laboratory period.

Lesson 7. Prop 65 Disclosure Requirements

Intent and Purpose

In this lesson, the student will be introduced to the California Prop. 65 disclosure requirements. These requirements involve a completely different scope than the HCS and Community Right-to-know laws covered earlier in this module. It will, therefore, be of interest to the student to compare and contrast these standards.

This lesson is purposely kept short to allow for a final exam to be given if this module was taught as a separate course. Alternatively, the requirements of a "final project" as recommended earlier in the module can be reviewed.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Explain** the basic statutory intent of Prop. 65.
2. **List** responsibilities of the state, business, and government employees under the law.

Lesson Outline

1. Describe political history and background of Prop. 65.
2. Explain basic provisions:
 - Statutory intent
 - State responsibility
 - Responsibilities of business
 - Responsibilities of government employees
3. Describe enforcement provisions
 - Rewards (bounty provision)
 - Governmental employee reports

Suggestions for Development and Presentation

This law has an interesting political history that should elicit lively discussion by the class. It may be interesting to have a representative of either one of the groups that supported or opposed the initiative to give his or her perspective in retrospect.

Basic provisions can be made into overheads that can be handed out to the students in order for them to follow along with the lecture.

References and Resources

- Dufour, James T., *Proposition 65 Handbook*, California Chamber of Commerce.
- *California Health and Safety Code*, Section 25249.5 et seq. (In Appendix of *Proposition 65 Handbook* noted above).

Schedule and Assignments

- Other than handouts received in class, there are no other assignments for this topic

Lab 7. Training Presentations

Intent and Purpose

In this laboratory exercise, students will wrap-up their work on Right-to-know laws by giving individual training presentations. Groups should work together by having individual members give portions of a broader presentation.

Laboratory Objectives

To successfully complete this exercise, the student will be able to:

1. *Develop* a short training presentation (5-7 minutes) that utilizes concepts on learning covered in lesson 3.
2. *Clearly write* at least two learning objectives for the training presentation.

Pre-Lab Outline

1. Students should be told that they will be timed and cannot go over the 7 minute limit. They must submit the identified learning objectives to the instructor prior to making their presentations.
2. Students will be evaluated on how well they achieved their stated learning objectives and on their presentation skills.
3. As they listen to presentations, students should make note of techniques that seem especially effective for a post-lab discussion.

Laboratory Exercise

1. Each student gives a 5-7 minute training presentation meeting a requirement of their Business Plan and HazCom Program.
2. After all presentations have been given, students should provide constructive feedback in a class discussion.

Suggestions for Development and Presentation

This laboratory exercise gives the students an opportunity to have fun with some of the earlier concepts. Some of the students may be apprehensive about speaking in front of the class so it is important to promote this as a positive and non-threatening experience for them. Help them to be relaxed and maintain an encouraging atmosphere in the classroom.

References and Resources

There are no new references and resources for this exercise.

Schedule and Assignments

This laboratory is suggested to take 3 hours of classroom time.

This is the final laboratory period for this module so all lab work should be turned in. If a “final project” was assigned, students should be given a couple of weeks to complete it.

Transportation of Hazardous Materials

Instructor's Guide

Prepared By:

Ann Boyce
Bakersfield College
1801 Panorama Drive
Bakersfield, CA 93305
(805)395-4552

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Preface

This is the instructor's guide for a module entitled *Transportation and Storage of Hazardous Materials*.

This module is part of *Hazardous Materials Management Applications*, a 4 unit lecture/laboratory core course in the EHMT Associate Degree and Certificate Program. The course is designed to provide students with hands-on instruction in the *applications* of major laws and regulations dealing with hazardous materials.

The course has been divided into three modules:

- **Module I Right-to-Know Laws**
- **Module II Transportation & Underground Storage**
- **Module III Air Quality Issues**

This modularization has been designed in such a way that the course can be taught as three separate "mini-courses." Modules I and II are each 45 hours and therefore represent 1.5 lecture/lab units (7 lessons and 7 labs each account for 42 hours, the remaining three hours are for finals and other tests, etc.). Module III is 18 hours so can be taught as a 1 unit course.

Modularization will allow the maximum flexibility for individual colleges to meet both traditional educational goals **and** the immediate needs of local industry. This flexibility is evidenced by the following available options, since the modules can be used in whole or part for:

- **Contract Education**
- **Community Service Classes**
- **Degree and Certificate Applicability**

The lab exercises have also been designed with this flexibility in mind. Each lesson plan is for one week, or three hours, of lecture time. Associated with each lesson is a three hour lab exercise. Lab exercises can be taught either in a separate three hour lab period **or** can be alternated with lecture topics in an integrated course approach.

Transportation of Hazardous Materials

Module Description

This module is comprised of 45 lecture/laboratory hours covering the following aspects of storage and transportation of hazardous materials (substances):

- Introduction and History
- Regulatory Requirements
- Modal Requirements for Transporting Hazardous Mat'ls
- Proper Completion of Shipping Papers
- Existing Tank Standards
- New Construction Requirements for Underground Tanks
- Abandonment/Closure of Underground Tanks
- Regulatory Inspection & Enforcement Considerations
- Use of Resources and Other Sources of Assistance
- Recordkeeping and Reporting Requirements

Specific objectives are listed for each of the 7 lessons and 7 laboratory exercises described in this module.

Texts

Suggested Student Texts:

Transportation: *CFR 49*, Parts 100-177

Underground Tanks: *CFR 40*, Parts 280 & 281; Chapter 6.7, *California Health and Safety Code*; Title 23, *CCR*.

Instructor Resources and References are described within this document.

Instructor Note

Note to Instructors: It is suggested that the instructor using this module read through **all** lessons and labs prior to starting the course. In this way, later concepts which are built on earlier activities can be better anticipated and planned for.

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Framework: Hazardous Materials Transportation

Intent and Purpose

In this lesson, the broad framework of the federal Hazardous Materials Transportation Act (HMTA) and associated regulations in Title 49, CFR is covered. A foundation is laid using the background and history of the regulations so that students will understand both their purpose and relevance. The California enforcement interface is also covered.

The general definitions and terminology used in the transportation regulations are covered with emphasis on use of the definitions in a legal sense; many of the definitions may run counter to a student's day-to-day or intuitive use of the same term.

Differences and similarities between the California and Federal regulations and enforcement schemes are highlighted by comparison of scope and basic requirements.

To successfully complete this lesson, the student will be able to:

1. **Explain** why the Hazardous Materials Transportation Act was enacted.
2. **List and describe** the five major provisions of the Standard.
3. **Identify** who is regulated and who is protected based on an understanding of the scope of both federal and state regulations.
4. **Describe** the basic differences between state and federal regulations.
5. **Define** general terms listed under "definitions" in Section 171 of the federal regulations.

1. If desired, a "Skills Survey" can be given before actual instruction begins. Selected basic questions about the material to be covered can be compiled by the instructor for this purpose. This can be beneficial because it lets the instructor know the level of understanding by the students **prior** to instruction and it gives the students a better feel for what they will be expected to know **after** instruction.

2. The module should be introduced with an explanation of goals and objectives as well as grading criteria.

3. Historical background of HMTA is introduced including:

- Early history of Federal law
- Role of ICC and the Bureau of Explosives
- Formation and organization of the Department of Transportation
- The HMTA of 1975

- Statistical background on transportation incidents
4. Current regulatory framework covered, including:
- Relationship between interstate and intrastate requirements based on federal and state regulations.
 - Summary of DOT Hazardous Materials regulations covered in *CFR 49*.
5. Basic provisions and requirements of State and Federal regulations are discussed, including:
- Classification of Hazardous Materials
 - Hazard Communication
 - Shipping Papers
 - Labels
 - Markings
 - Placards
 - Packaging
6. The general definitions of the regulations are reviewed with emphasis on how they apply to scope & requirements, including:
- “Hazardous Material”
 - “Hazardous Substance”
 - “Hazardous Waste”
 - “Limited Quantity”
 - “Liquid”
 - “Mixture”
 - “Mode”
 - “Motor Vehicle”
 - “Navigable Waters”
 - “Packaging”
 - “Reportable Quantity”
 - “Research and Special Programs Administration” (RSPA)

- “RSPA”
- “Shipping Paper”
- “Solid”
- “Solution”
- “State Routing Agency”
- “Technical Name”
- “Transport Vehicle”
- “Viscous Liquid”

Suggestions for Development and Presentation

It is important not to go into too much detail until a solid foundation comprised of the purpose, scope, and basic requirements of the regulations is developed. The student will achieve greater understanding by initially focusing on the overall framework of the law. The student needs to read and apply the requirements of the Transportation regulations to fully appreciate their grey areas. This will be accomplished in the laboratory exercises.

Overhead Transparencies can be effectively used in presenting information on historical background and basic provisions of the regulations. The resource materials provided for this lesson can be used to make transparencies. The resources can also be used as handouts for the students as they are from non-copyrighted government publications.

The discussion of definitions and terminology would be enhanced by the use of visuals depicting various images that require thoughtful application of the definitions. Examples are:

- Pictures of the various modes of transportation
- Groups of chemicals to determine whether they are “hazardous materials”, “hazardous substances”, or “hazardous wastes”
- Groups of chemicals (may be same group as above) to determine whether they are “mixtures”, “solutions”, solids”, “liquids”, etc.

References and Resources

Background and History of HMTA:

- *Transportation of Hazardous Materials*, Office of Technology Assessment, U.S. Congress, July 1986
- HMTRI, *Course HMT 230*, Pages 1-8 through 1-10
- *Transportation of Hazardous Materials: State and Local Activities*, OTA, U.S. Congress, 1986

Current Regulatory Framework:

- *Transportation of Hazardous Materials: State and Local Activities*, OTA, 1986, pages 6 & 7.
- *Transportation of Hazardous Materials*, OTA, 1986

Basic Provisions and Requirements:

- *CFR 49*, 171.1 through 171.7
- *Transportation of Hazardous Materials*, OTA, 1986

Definitions:

- *CFR 49*, 171.8

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments by Lesson Outline topic number are as follows:

- Topics 3-4; Excerpts from OTA publications
- Topics 5-6; *CFR 49*, Subchapter C, 171.
- *CFR 49*, Subchapter C, 172, Subpart C should be read by students prior to Laboratory Exercise #1.
- Students should bring information on 4 hazardous materials found at home or in the workplace to Laboratory Exercise #1. Information should include a list of ingredients and their percentages in the mixture, if possible.

Determining Hazard Class and Shipping Name

Intent and Purpose

In this laboratory exercise, the Hazardous Materials Table and the hazard classifications described in DOT regulations are studied to give the student the opportunity to determine proper shipping names for transportation purposes.

It is assumed that students in this course have taken a basic chemistry class. This laboratory exercise will review several concepts related to fire chemistry. Emphasis should be placed on how these concepts apply in the context of appropriately describing a hazardous material to be shipped. Examples of common workplace materials are used to make these determinations.

The legal definitions as stated in the regulations for the applicable hazard classifications will be reviewed and applied. The student will also explore resources and references providing necessary chemical information.

Laboratory Objectives

To successfully complete this exercise, the student will be able to:

1. ***Describe and define*** the nine general hazard classifications used in the Hazardous Materials Transportation regulations.
2. ***Find*** necessary information on specific chemicals using a variety of common references and resources in order to properly classify and name hazardous materials to be shipped.
3. ***Determine*** the proper “basic description” for a variety of chemicals and chemical mixtures.
4. ***Calculate*** the “Saturated Vapor Concentration” for chemicals to determine if they meet the definition of “Poison-Inhalation Hazards”.

Laboratory Exercise

1. The following definitions applicable to this laboratory exercise are reviewed:

- “Atmospheric gases”
- “Basic Description”
- “Compressed Gas”
- “Cryogenic Liquid”
- “Flash Point”
- “Forbidden Materials”
- “Not Otherwise Specified” (N.O.S.)
- “Poison- Inhalation Hazard”
- “Proper Shipping Name”
- “Pyrophoric Liquid”
- “Spontaneously Combustible Material”
- “Technical Name”
- “Water-Reactive Material”

2. The following general hazard classification definitions are reviewed and examples of each are given:

- Class 1: Explosives
 - Class A
 - Class B
 - Class C
- Class 2: Gases (compressed, liquefied, or dissolved under pressure)
 - Flammable Gas
 - Nonflammable Gas
 - Poison A
- Class 3: Flammable Liquids
 - Combustible Liquid
 - Flammable Liquid
- Class 4: Flammable Solid
- Class 5: Oxidizing Agents and Organic Peroxides
 - Organic Peroxide
 - Oxidizer
- Class 6: Poisonous and Infectious Substances
 - Poison B
 - Irritating Material
 - Etiologic Agent
- Class 7: Radioactive Material
- Class 8: Corrosive Material
- Class 9: Miscellaneous Dangerous Substances
 - ORM-A
 - ORM-B
 - ORM-C
 - ORM-D
 - ORM-E

3. Important concepts associated with determining the proper shipping name are covered, including:

- Use of the Hazardous Materials Table
- Hierarchy of the Hazard Classes
- Determining the shipping name for mixtures
- How to deal with “mixed loads” (hazardous and non-hazardous materials)
- Calculating the Saturated Vapor Concentration

Environmental Technology

4. Be sure resources and references listed in that subheading below are available for use in the classroom.

1. The students should work individually on worksheets that will reinforce the information provided in this laboratory exercise. An example worksheet is provided in the attachments.

2. Give each group approximately 6 different MSDS's describing materials from different hazard classes. All campuses should have a large selection of MSDS's to choose from. Students can work in small groups to determine the following from the MSDS's:

A. List the hazard class(es) each would fall under.

B. Determine the proper "basic description" for each.

C. Calculate the "Saturated Vapor Concentration" for each.

3. Each group should select at least two other chemicals from their "chemical inventory" (ingredients listed from home products that they were supposed to bring to lab). Since they have no MSDS's for these materials, they must use common references and resources to determine the same information as in #2 A,B,C above.

4. After the students have had some time to work on this exercise it may be beneficial to discuss the rationale and results of hazard class and proper shipping name determinations to make sure they are on the right track. Stress the need to utilize the most descriptive proper shipping name and use of the mixture rule for determining proper shipping names.

Suggestions for Development and Presentation

Given the large amount of information and specific requirements of law covered both in this exercise and in Lesson 1, it is suggested that the worksheet be used to reinforce new learning as each topic is covered. A sample worksheet is included that covers the basic concepts involved with proper use of the Hazardous Materials Table. Using a worksheet such as this will help to make sure students understand the basics before tackling the MSDS's and their own "chemical inventories".

The instructor should go through a number of examples while covering the specifics of the regulations.

There are a number of excellent videos and packaged slide presentations that cover the DOT hazard classifications. Examples are:

- Hazard Productions, *Introduction to Reactive and Explosive Hazards*
- Transportation Skills Program, *Classes of Hazardous Materials, Chemicals, and Wastes*

References and Resources

Definitions and Hazard Classes:

- *CFR 49, Part 171*

- DOT information sheets attached
- U.S. Congress OTA, *Transportation of Hazardous Materials*, Chapter 4.
- HMTRI, *Course HMT 230*, pp 1-11 through 1-17

Other Requirements:

- *CFR 49*, Part 172

The following minimum resources should be made available to students during the lab session:

- NIOSH, *National Registry of Toxic Effects*
- Hawley, Gessner, *Condensed Chemical Dictionary*, Van Nostrand Reinhold
- Sax, Irving, *Dangerous Properties of Industrial Materials*
- NIOSH, *Pocket Guide to Chemical Substances*, U.S. Government Printing Office
- ACGIH, *Threshold Limit Values and Biological Exposure Indices*

Other references can be used as well.

Schedule and Assignments

This laboratory is suggested to take 3 hours of classroom time.

With all the prelab material to be covered, it may take more than the 3 hours allotted to finish this lab. If so, it can be completed during the next lab period. This lab covers very important basic information, so adequate time should be spent to assure that students fully understand requirements.

Students should read *CFR 49*, Part 172, Subparts D, E, and F for lesson 2.

Transportation Hazard Communication Requirements

Intent and Purpose

In this lesson, the student will learn the requirements for hazard communication under DOT hazardous materials transportation regulations. This will include: packaging criteria, shipping papers, marking requirements, and labels/placards. This will prepare the student for the next laboratory exercise which will involve application of the hazard communication requirements to the shipping of several materials.

The general definitions and terminology used in the transportation regulations should already have been covered in the first lesson. This lesson should emphasize specific requirements.

Lesson Objectives

Environmental Technology

To successfully complete this lesson, the student will be able to:

1. **Explain** general packaging criteria in *49 CFR*.
2. **Describe** the difference in requirements for nonbulk (small) and bulk (large) containers.
3. **Explain** what shipping papers are used for and what information they must contain.
4. **List** general marking requirements for non-bulk containers of hazardous materials.
5. **Identify** labels and placards associated with the various hazard classes and describe general requirements for their use.

Lesson Outline

1. Review major requirements for labeling, under *CFR 49*, Part 172, Subpart E:
 - Required labeling
 - Multiple labeling
 - Exemptions
2. Review major requirements for markings, under *CFR 49*, Part 172, Subpart D:
 - Non-Bulk requirements
 - Technical name
 - Exemptions
 - Other specific marking requirements (e.g. “This End Up”)
3. Review major requirements for placards, under *CFR 49*, Part 172, Subpart F:
 - Mixed loads of two or more different classes of materials
 - Exceptions
 - Restrictions

Suggestions for Development and Presentation

The attached information from DOT and other sources can be used to make overheads for lecture purposes. Examples of labels and placards should be obtained and displayed in class.

References and Resources

Packaging Criteria:

- HMTRI, , Pages 2-22 through 2-40
- CFR 49, Part 173
- *Transportation of Hazardous Materials*, OTA, 1986, Chapter 3

Labels, Markings, and Placards:

- *Transportation of Hazardous Materials*, OTA, 1986, pages 149-152.*
- CFR 49, Part 172
- HMTRI, *Course HMT 230*, Lesson 2

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments by Lesson Outline topic number are as follows:

- Topics 1: CFR 49, Part 172, Subpart E
- Topic 2: CFR 49, Part 172, Subpart D
- Topic 3: CFR 49, Part 172, Subpart F

Proper Packaging, Labeling, Marking, and Placarding

Intent and Purpose

In this laboratory exercise, the student will utilize information learned in the previous lessons and lab to determine the proper packaging, labeling, marking, and placarding of various hazardous materials.

Laboratory Objectives

To successfully complete this exercise, the student will be able to:

1. **Determine** the proper packaging for hazardous materials shipments.
2. **Apply** the appropriate labels and markings to a hazardous materials shipment.
3. **Demonstrate** proper use of Placarding Tables 1 & 2 to determine required placard(s).
4. **List and describe** methods of package testing.

Pre-Lab Outline

1. The following definitions applicable to this laboratory exercise are reviewed:

- “Bottle”
- “Bulk Packaging”
- “Carboy”
- “Cargo Aircraft Only”
- “Cargo Tank”
- “Cargo Vessel”
- “Consumer Commodity”
- “Cylinder”
- “Freight Container”
- “Gross Weight”
- “Magnetic Materials”
- “Maximum Allowable Working Pressure”
- “Non-Bulk Packaging”
- “NRC” (Non-Reusable Container)
- “Outside Container”
- “Overpack”
- “Package” or “Outside Package”
- “Passenger-Carrying Aircraft”
- “Passenger Vessel
- “Placarded Car”
- “Portable Tank”
- “Residue”
- “STC” (Single-Trip Container)

- “Strong Outside Container”

2. The use of Placarding Tables 1 & 2 should be demonstrated.

Laboratory Exercise

1. Student groups should complete Laboratory Exercise #1.

2. Student groups should use the same hazardous materials as were used in Laboratory Exercise #1 to do the following:

- A. Prepare instructions for proper marking, labeling, and placarding of the materials for shipment.
- B. Prepare instructions on proper packaging for shipment.

Suggestions for Development and Presentation

This lab session should be used to complete lab exercise #1 and provide the added information required of this lab. It should not take much time for students to determine marking, labeling, and placarding once they have determined the proper shipping name. This will allow time in this lab to go over packaging definitions. These types of definitions are best suited to a slide presentation showing a “carboy”, for instance.

References and Resources

The instructor should go through an example of use of Placarding Tables 1 & 2.

Definitions:

- *CFR 49*, Part 171
- DOT information sheets attached
- HMTRI, *Course HMT 230*, Lesson 2

Labeling, Marking, Placarding:

- *CFR 49*, Part 172, Subparts D, E, and F
- DOT information, attachments for Lesson 2

Packaging:

- *CFR 49*, Part 173, Subparts A and B
- HMTRI, *Course HMT 230*, Lesson 2.
- DOT information, attachments for Lesson 2

Schedule and Assignments

This laboratory is suggested to take 3 hours of classroom time.

Laboratory Exercises 1 & 2 should be completed and turned in during this session.

Carrier Requirements

Intent and Purpose

In this lesson, students will learn about the DOT requirements that apply to carriers of hazardous materials. These requirements are extensive so this lesson will cover only some of the major handling, loading, and unloading provisions as well as pertinent definitions.

An important aspect of carrier requirements are the different forms of shipping papers and segregation and separation charts for the various modes of transportation.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Explain** the general requirements regarding loading and unloading of hazardous materials from motor vehicles.
2. **Describe** the procedure for handling hazardous materials that cannot be delivered.
3. **Identify** the information required on a dangerous cargo manifest.
4. **Describe** the regulations governing the loading, unloading, and handling of hazardous materials shipped by aircraft.
5. **Explain** use of segregation and separation tables and requirements.

Lesson Outline

1. Definitions are reviewed:

- “Captain of the Port”
- “Carrier”
- “Chock”
- “Fissile Material”
- “Magazine”

- “Millirem”
- “Switching Ticket”

2. Explain Hazardous Material Carrier Requirements, including:

- Exemptions
- Motor Carrier driving and parking rules
- Location of Shipping Papers
- Loading and Unloading
- Segregation and Separation of Hazardous Materials
- Differences in required shipping documents between various modes of transportation

Suggestions for Development and Presentation

HMTRI, *Course 230*, Lesson 3 provides in organized form a good overview of these requirements. This is very helpful since they are spread out over many pages of several federal codes. For this reason, it would be best to develop overheads that address key points from the Iowa material.

The material in this unit can be extremely cumbersome so it is important not to go into too much detail. Students should become familiar with the concepts and terminology.

References and Resources

Definitions:

- HMTRI, *Course HMT 230*, Lesson 3

Hazardous Material Carrier Requirements:

- HMTRI, *Course HMT 230*, Lesson 3
- *CFR 49*, Parts 174 - 177

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments by Lesson Outline topic number are as follows:

- Topics 1 and 2: Excerpts from HMTRI publications and *CFR 49*, Parts 174 - 177

Shipping Papers

Intent and Purpose

In this laboratory exercise, students will complete shipping papers for various hazardous materials. Doing this will reinforce the information learned in previous lessons and labs.

Laboratory Objectives

To successfully complete this exercise, the student will be able to:

1. **Determine** what information is needed to ship hazardous materials in compliance with DOT regulations.
2. **Complete** shipping papers for a variety of hazardous materials.
3. **Identify** materials that should be separated or segregated while utilizing various modes of transportation.

Pre-Lab Outline

1. Any material in previous lessons or labs that presented problems to the students or was not covered in sufficient depth should be reviewed.
2. All discussions of previous lab work should be finalized so that students have the benefit of a final learning experience.

Laboratory Exercise

1. The students should work individually on this exercise.
2. Each student should be given blank shipping paper forms and 4-5 MSDS's. For each material, they should fill out separate shipping papers. At least one of the MSDS's should represent a "hazardous substance" with a "RQ" listing. MSDS materials should be varied for optimum practice for the student. The instructor should also provide information on the amounts of each material to be shipped. Keep in mind that the next exercise will require reporting when developing quantities.
3. Materials on MSDS's should be listed on a chart developed by the student to show separation and/or segregation requirements if shipped by rail, air, or highway.

Be sure any areas causing confusion or problems are covered at the beginning of this exercise. Since students are working independently, be sure to provide assistance in the classroom, as needed.

Extra copies of segregation/separation charts and information must be available for this exercise.

See handouts and references for previous lessons and labs.

Schedule and Assignments

This laboratory is suggested to take 3 hours of classroom time.

The exercises should be turned in at the end of this lab session so students need to use their time efficiently.

Emergency Response

Intent and Purpose

In this lesson, the student will be introduced to emergency response guidelines for transportation emergencies. This is in preparation for Laboratory Exercise 4, during which the student will fill out appropriate reporting forms.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Explain** the functions of information retrieval systems such as CHEMTREC.
2. **List and describe** basic federal incident reporting requirements.
3. **Identify** the type of information that must be reported.
4. **Describe** uses of the DOT *Emergency Response Guidebook*.

Lesson Outline

1. Review reporting requirements for hazardous materials transportation incidents.
2. Go over instructions for preparing DOT Form F.
3. Review requirements for accidental discharges of hazardous wastes during transportation.
4. Survey the technical assistance and information retrieval services and resources available for assistance in emergencies, including:
 - CHEMTREC
 - *Emergency Response Guidebook*
 - U.S. Coast Guard *CHRIS Manual*
 - EPA OHMTADS
 - U.S. Coast Guard National Strike Force

- Other Handbooks and References

Suggestions for Development and Presentation

Lesson 4 of the HMTRI, *Course HMT 230* provides a good summary of instructions for completing DOT forms. It also covers the available technical assistance and information retrieval services. It is advisable to have some of the reference books available for student inspection.

To explain use of the DOT Form F, the instructor should provide a blank copy that can be filled in by students as each section is covered. Lesson 4 from the HMTRI course has detailed instructions for completing this form.

References and Resources

Reporting Requirements:

- HMTRI, *Course HMT 230*, Lesson 4
- DOT handouts provided

Preparing DOT Form F:

- HMTRI, *Course HMT 230*, Lesson 4

Technical Assistance:

- HMTRI, *Course HMT 230*, Lesson 4

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments by Lesson Outline topic number are as follows:

- Topics 1-4; Excerpts from DOT publications provided.

Emergency Response

Intent and Purpose

In this exercise, various quantities of the materials for which students completed shipping papers in the previous lab session have met with accidental releases through transportation incidents. The students must, therefore, fill out appropriate reporting forms and detail their approach and timeframes for reporting.

Students will develop a short timeline with narrative explanations detailing who was called, what was reported, and when the reporting took place.

Laboratory Objectives

To successfully complete this exercise, the student will be able to:

1. Report hazardous materials incidents to proper agencies within required timeframes.
2. Complete appropriate reporting forms.
3. Develop a concise timeline and narrative report on various reporting functions.

Pre-Lab Outline

1. Explain the premise of this lab exercise; the hazardous materials shipped with appropriately completed shipping papers from the previous exercise have just been spilled due to transportation accidents.
2. Review the difficult agency and legal interfaces involved.

Laboratory Exercise

1. Emphasize that the “clock” starts now and that the exercise consists of:
 - a. Developing report and timeline detailing reporting activities including who was called, when the reports were made, and what was reported.
 - b. Completing appropriate reporting forms (as desired by instructor)
2. Be sure time is set aside to discuss the results of this exercise.

Suggestions for Development and Presentation

The requirements for reporting are complicated, especially given the overlap and varying authorities of the regulatory agencies involved. The DOT guidance documents attached to this lab and lesson 4 will help the student to put together a scheme for proper reporting. By attempting to do this and then discussing the results, students will have the best opportunity to understand reporting intricacies.

References and Resources

DOT informational documents are attached to this lab and lesson 4 for reference.

Schedule and Assignments

This laboratory is suggested to take 3 hours of classroom time.

This is the last laboratory exercise in the Transportation portion of this module. All exercises on this subject should be completed and submitted during this session.

Framework: Underground Storage Tank Standards

Intent and Purpose

In this lesson the broad framework of federal, state, and local underground storage tank (UST) standards are covered. The student will be provided with the background and history of the standards in order to understand their importance and relevance.

The student will be guided in utilizing the established laws and guidelines to plan and inspect activities and equipment at underground storage tank sites. These standards are enforced by different levels of government, and are designed to prevent significant, costly releases from underground storage tanks. They affect a broad spectrum of individuals and companies.

Definitions and terminology provided within the standards written for underground storage tanks must be reviewed with legal meanings emphasized. Differences and similarities between California, federal, and local standards are highlighted by comparison of definitions, scope, and basic requirements.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Explain** why federal and state underground storage tank standards were enacted.
2. **Describe** basic differences between state, federal, and local standards.
3. **Define** general terms listed under “definitions” in the standards.
4. **Identify** entities that are regulated or exempt from the provisions provided within state, federal, and local law.
5. **List and discuss** technical options available to prevent releases from underground storage tank systems as specified within the regulations.
6. **List** the laws which govern underground storage tanks at federal, state, and local levels.
7. **Describe** federal financial responsibility requirements and approved mechanisms for demonstration, deadline dates for compliance, and minimum requirements for coverage.
8. **List and discuss** the major causes of releases from underground storage tank systems.
9. **Discuss** the impact of the EPA regulations on UST facilities owned by “small businesses”, and the federal government’s view regarding their ability to comply.
10. **List** nationally recognized standards recognized within state and federal standards.

Lesson Outline

1. Remaining lessons of this module are introduced with an explanation of goals and objectives.

2. Historical background of underground storage tank standards are provided including:

- Documented releases from underground storage tanks within the Silicon Valley in California, and in Suffolk County New York, which brought federal, state, and local governments into the mitigation of releases from such systems.
- Initial legislation in California to provide standards for underground storage tank systems, specifically, the Cortese and Sher Bills, which specified the registration and eventual permitting of such systems.
- Survey results summarized within federal draft regulations explaining the current problems and justifying standard development.

3. Basic provisions and requirements of state and federal standards are discussed, including:

- Scope
- Registration
- Permitting
- Monitoring
- Construction (Installation)
- Upgrade for Existing Tanks
- Owner/Operator Responsibilities
- Financial Responsibility
- Release Investigations
- Removal (Closure)
- Penalties for Noncompliance

4. The general definitions within the standards are reviewed with emphasis on how they apply to scope and requirements including:

- “Automatic Line Leak Detector”
- “Board”
- “Cathodic Protection”, “Cathodic Protection Tester”
- “CERCLA”
- “Compatible”
- “Corrosion Expert”

- “Corrective Action”
- “Dielectric Material”
- “Department”
- “Double Walled Tank”
- “Existing Tank System”
- “Emergency Use”
- “Farm Tank”
- “Flow Through Process Tank”
- “First Ground Water
- “Facility”
- “Hazardous Substance”
- “Interstitial Monitoring”
- “Independent Testing Organization”
- “Implementing Agency”, “Local Agency”
- “Motor Vehicle Fuel”
- “Storage Tank”, “New Underground Storage Tank”
- “Owner”, “Operator”
- “Petroleum”
- “Pipe”
- “Primary Containment”
- “Regulated Substances”
- “Release”
- “Substantially Beneath The Surface of the Ground”
- “Sump”
- “SWEEPS”

- “Single Walled”
- “Storage”
- “Tank”, “Underground Storage Tank”
- “Integrity Test”, “Tank Tester”
- “Underground Tank System”
- “Unauthorized Release”
- “Voluntary Consensus Standard”

Suggestions for Development and Presentation

Before concentrating on the standards, provide the student with an overview of underground storage tank systems, their advantages and disadvantages. Discuss the documented releases, and the problems created from such releases. Describe how different states attempted to solve underground storage tank problems before the federal government became involved. With this background, the student will be able to better understand the language within the federal, state, and local standards.

The student needs to read and apply the laws and regulations to fully appreciate the basic requirements imposed by the various levels of government and the grey areas that every regulation possesses. This is accomplished in the laboratory exercises.

Videos can provide information on the documented releases and the public response to such releases. Overhead transparencies will also help to clarify requirements and exemptions provided to underground storage tank facilities. Slides and videos also give the inexperienced student an idea of the appearance of underground storage tank systems.

The discussion of definitions and terminology would be enhanced by the use of slides depicting various images that require thoughtful application of the definitions. Examples are:

- Slides of different tanks to determine which seem to meet the definition of an underground storage tank or meet one or more of the exemptions categories (ex. basement tanks, vaulted tanks, emergency storage areas with tanks below grade, flow-through, or process tanks).
- Underground storage tank leak detection equipment
- Profiles showing plume dispersions from underground storage tanks.
- Installed cathodic protection systems, with a diagram of the electron flow with galvanic and electrolytic corrosion.
- Slides showing different types of underground storage tank facilities (e.g. service stations, small business with one tank, abandoned dispenser at old, no longer in use facility, and new sites with state-of-the art equipment).

References and Resources

Background and History of Underground Storage Tank Standards:

- Preamble, *40 Code of Federal Regulations*, Parts 280 and 281, “Federal Register”, September 23, 1988
- Magazine and newspaper articles about Silicon Valley problems, etc.

Basic Requirements of Standards:

- Federal and state laws and regulations (also many of the governmental publications listed under “Instructor Resources and References” in the introduction to Module II have good summaries that can be made into overheads).
- *Uniform Fire Code*, Pertaining to Storage of Flammable and Combustible Liquids

General Definitions and Terminology:

- Each law/regulation will have a list of terminology which clarifies the limits and intent of the standard. Review the definitions which are not common to normal use.

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments by Lesson Outline topic number are as follows:

- Topic 3: Preamble to draft *40 CFR* parts 280 and 281; original Cortese and Sher Bills which provide legislative intent; appropriate excerpts from periodicals and/or governmental resources listed.
- Topics 4 & 5: Initial parts of Federal UST Regulations - *40 CFR* parts 280 and 281 and State UST Statute and Regulations relating to definitions, scope, etc.

Lab on the Underground Storage Tank Standards

Intent and Purpose

Within this lab students will utilize information obtained during the review of legal requirements covered in Lesson 5 to determine whether certain sites are subject to regulation. They will research the conditions under which the facility may be exempt from some or all of the requirements specified within the regulations. An understanding of the enforcement deadlines, exemption categories, penalties, and variations available within State and Federal standards are required to make these determinations.

Laboratory Objectives

To successfully complete this exercise, the student will be able to:

1. **Apply** appropriate dates for which state and federal standards were in affect.
2. **Determine** whether substances are regulated, or hazardous, and for which permits are required.
3. **Understand** the exemptions that are available in federal and state laws and regulations for underground storage tanks.
4. **Describe** the penalties which can be imposed upon a facility owner and operator that do not comply.
5. **Evaluate** a scenario for all implications and liabilities for the tank owner, operator, and the fuel distributor or environmental contractor listed.

Pre-Lab Outline

Review important aspects of Lesson 5 as they pertain to owners, delivery services, and contractors. State again where that information is within the study material.

Explain the assignment that follows, and the expectations for students to read carefully, and be thorough in the discussion of concerns.

As much as possible of the assignment should be completed in class because the last 30-45 minutes of class time can be reserved for questions about the exercise. This will enable students to have concerns and questions immediately answered before taking the assignment out of class to complete.

Laboratory Exercise

1. Each student will receive information on three scenarios that represent cases located in three different areas. For each, the student will assume a different role for the purposes of completing a written evaluation. For one scenario the student will assume the role of a tank owner, the second, a fuel distributor, and the third, an environmental assessment/tank service contractor.
2. The student must review the scenario, and answer all questions that relate to the role that he or she is playing, utilizing the information reviewed in Lesson 5. It is important that the student utilize good writing skills and be thorough in evaluating the implications of the scenario while summarizing relevant concerns. As in actual situations, the overlooked concerns may be costly, as in points assigned for the project.
3. The student should utilize available references, however, may only have class time to use some of them. For this reason, it is important for the student to utilize lab time effectively.
4. This is **not** a group project. Each student will complete the assignment without assistance from the others, however, students can voice questions at the end of the period for all to benefit from. After turning in the assignment the entire class will again discuss answers, and the instructor will reinforce important responses.
5. The following are example scenarios that can be used as is, or changed, if desired, by the instructor:

Scenario A—

Environmental Technology

You own 20 acres of land in Orlando, Florida. One half of the property is currently being used to grow oranges.

You have two 1000 gallon underground storage tanks used to store gasoline, located on the farm. One tank (#1) is used to fuel farm equipment, such as tractors and planes. The other (#2) is not being used. It was purchased and installed to allow you to store the larger quantity of fuel that you anticipated needing during the period when fuel prices were soaring.

You filled tank #2 in 1972, and had need to only use 50 gallons from it. Those 50 gallons were used to fuel your own private vehicle. The reason you stopped using it was that the quality of fuel within the tank became questionable after you experienced some problems with your engine during the second fill. You called the distributor and he assured you that he had not delivered water, since the fuel within both tanks came from the same source, and the tank used for agricultural vehicles had not presented the farm with any problem.

You were advised to stick a gauging instrument down the tank. You did and discovered 2 inches of water at the bottom of the tank one day and 4 inches of water in the tank the next. You decided to discontinue use of the tank at that time. In 1988 you decided to more permanently close the tank from unauthorized use by sealing the fill cap to the fill. You also removed the dispenser and vent lines. The tank is only evident by the presence of the sealed fill cap which rises a bit above the asphalt cover.

A representative of the fuel distributor tells you of registration requirements while delivering fuel one day in 1989.

Answer the following:

1. How many tanks are you required to report to the state on the registration form, and why?
2. Is the owner responsible for environmental damage caused by the possibility of leaking fuel from the tank that was sealed? Why?
3. List all problems that are evident from this scenario regarding the tank owner's activities.
4. What situations might cause the sealed tank to be discovered?

Scenario B—

You represent a fuel refinery operation that distributes gasoline and diesel to facilities throughout California. You have just reviewed the draft regulations from EPA on Underground Storage Tank registration and have decided to notify all of your clients of the new EPA regulations.

You prepare a flyer which will discuss the registration, and upgrade requirement that EPA has formulated within their regulations.

Answer the following regulations regarding the contents of the flyer:

1. Who will be the recipients of the flyer?
2. What will the flyer state regarding the EPA requirements, and deadlines?

3. What must the you consider as far as local concerns?

Scenario C—

You work for APX Environmental in Stockton, California. You have just been given a new position, which is involved with compliance with Underground Storage Tank Regulations. A new potential client comes into the office, who has received some alarming information about new compliance regulations within the state and federal government. He states that these regulations might require that he spend millions of dollars to upgrade, insure, and monitor his underground storage tanks.

A little bewildered, he asks that you look over his facility and give him an idea of what he is going to be required to do based on State, Federal and Local requirements. (Note at the time of this inspection, Stockton is following the state regulations.)

You go to his site and observe the following:

—He has four 5,000 gallon underground storage tanks which are plumbed to two dispenser islands. The Underground Storage Tanks store unleaded, super-unleaded, and regular gasoline.

—All tanks are steel, with no cathodic protection and were installed in 1969.

—He has no overfill protection, and you observe fuel puddled around each fill pipe. He has no Phase I or Phase II vapor recovery. He has metal piping which is not cathodically protected.

—The facility owner has never registered his tanks with the local permitting authority.

Provide the following information from a short report that you are going to prepare for the facility owner:

1. What are the immediate concerns that he must address regarding the facility and environmental compliance regulations?
2. What are the regulations that he needs to be aware of, specifying requirements for upgrading his facility?
3. What would you recommend that he do before trying to obtain financial responsibility coverage insurance?

Suggestions for Development and Presentation

Encourage students to read the laboratory exercise and to ask questions if not clear how to begin. The instructor should move around the classroom checking to make sure everyone is on the right track. If a student is completely off-base, clarify without giving too much of the information expected to be obtained by the student. You may want to direct the student to a certain page or section of a reference which will clarify the requirements.

During the last 30-45 minutes of the period, allow students to ask pertinent questions and let other students respond. This will get the students thinking in other directions they may have missed. After the exercise is turned in (at next lab session), ask open questions of the students to draw out all the important considerations for reinforcement.

References and Resources

Use the list for Lesson 5; there are no additional references and resources.

Schedule and Assignments

Students should be given the scenarios and questions at the beginning of the class period. The laboratory exercise is to be worked on independently until the last 30-45 minutes before the end of the laboratory period. At this time, allow for discussion and questions.

No more than the first hour of this laboratory exercise should be devoted to the review of Lesson 5 information and discussion of the assignment. Students will get more out of solving the problems posed for them in the scenarios. A good prelab discussion, however, is crucial for the students' success in this exercise.

Existing Tanks: Permitting, Monitoring, Upgrading, & Reporting

Intent and Purpose

In this lesson, the minimal requirements for operation of an existing underground storage tank system will be covered. The student will review basic definitions prior to being guided through a discussion of the different types of tank systems which meet the criteria for existing underground storage tanks, and their current and pending requirements for operation.

Again the differences and similarities between the California and Federal requirements will be highlighted, by comparing the regulatory limitations for operation, monitoring, upgrading, and release reporting.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **List** different types of underground storage tanks which meet the criteria of “existing”, and discuss their problems, and potential for releases.
2. **Identify** the registration, monitoring and upgrading standards for each type of existing underground storage tank system (based on tank material, tank age, piping material, pipe age, environmental sensitivity, and tank condition).
3. **Describe** the limitations of technology and equipment available and being developed which enable the tank owner to bring a system into compliance with State and Federal Standards.
4. **Discuss** the availability of coverage to meet Financial Responsibility Requirements.
5. **List** the reporting requirements, and recommended practices when an unauthorized release is detected or suspected.
6. **List and describe** guidelines developed on establishing acceptable practices in corrosion protection, tank lining, tank monitoring, etc.

Lesson Outline

1. Review of specifics of definitions emphasized within this lesson, including:

- “Automatic Line Leak Detector”
- “Cathodic Protection”
- “Corrosion Expert”
- “Existing Tank Systems”
- “Occurrence”
- “Release”
- “Tank Integrity Test”
- “Tank Tester”
- “Upgrade”
- “Unauthorized Release”
- “Voluntary Consensus Standard”

2. Contrast how existing facility standards differ from other standards.

3. Cover major existing facility monitoring, permitting, testing, and reporting requirements.

4. Explain financial responsibility provisions.

Suggestions for Development and Presentation

Begin by discussing the concept of an existing underground storage tank system, and the types of tanks which fall into this category, as defined in California and Federal Regulations. Discuss the potential for each type of system to release product, and the guidelines developed to ensure that the tank systems are monitored and upgraded to prevent releases. Discuss the registration, monitoring, upgrading, and insurance requirements for each type of tank system.

The student needs to read guidance documents to obtain an appreciation for the complexity of complying with the regulations. The student must also understand the different types of monitoring methods, and the steps that the government and state are taking to provide uniformity in the standards.

Environmental Technology

Videos can provide a summary of different leak detection methods (as tightness testing techniques, in tank level sensors, manual gauging and inventory reconciliation, vapor monitoring, water monitoring, and pressurized piping leak detectors).

Slides can be used to give the student an idea of types of equipment used for leak detection, corrosion protection, and overfill protection.

The availability of Financial Responsibility coverage can then be discussed, with information on the companies which offer policies to existing facilities, the cost of coverage, and their prerequisites for writing a policy. A guest speaker from the insurance industry would provide an interesting perspective.

References and Resources

- *Straight Talk on Tanks*, U.S. Environmental Protection Agency Bulletin, Office of Underground Storage Tanks, August 1990.
- *40 CFR* Parts 280 and 281, Subpart C— General Operating Requirements, Section 281.21 and 281.22 Subpart B, and Subpart D- Release Detection.
- “California Underground Storage Tank Regulations”, Title 23, Articles 4, 5, and 6.
- *Musts for Ust’s*, U.S. Environmental Protection Agency Bulletin, Office of Underground Storage Tanks.
- *Dollars and Sense*, U.S. Environmental Protection Agency Bulletin, Office of Underground Storage Tanks
- *Leak Lookout*, U.S. Environmental Protection Agency Bulletin, Office of Underground Storage Tanks

Schedule and Assignments

This lesson is suggested to take three hours of classroom instruction.

Student reading assignments per lesson objective number are as follows:

- Topic 1: Review definitions provided in *40 CFR* and State Regulations, and read the introduction to *Leak Lookout*.
- Topics 2 & 3: Review *40 CFR*, Parts 280 AND 281, Subparts B, C, and D; *California’s Code of Regulations*, Articles 4, 5, and 6; *Straight Talk on Tanks* and *Musts for Ust’s*.
- Topic 4: *Dollars and Sense*.

Students should complete these reading assignments prior to lab #2.

Existing Tanks: Permitting, Monitoring, Upgrading, and Reporting

Intent and Purpose

In this laboratory exercise, the students will work in small groups. The work groups will be given their assignment to review the problem and come up with the answers, and have a **representative** of the group summarize their results toward the end of the class session.

The assignment will be an application for a permit to operate an underground storage tank facility. The facility will have 3 to 4 tanks located an area with unique environmental conditions. The application will provide all information needed for the group to develop a permit with monitoring, and upgrade and financial responsibility requirements. Each group may have a different application.

The students can use reference information that they obtained in lessons 5 and 6. They will be expected to review the facility application, discuss, and develop a list of monitoring alternatives which will be acceptable to the facility based on its location, and the both federal and state standards. They must justify the reason for their choices. They must then formulate the permit for operation for the facility with the monitoring alternatives within the permit.

Laboratory Objectives

To successfully complete this exercise, the student will be able to:

1. **Apply** deadlines for upgrading and monitoring requirements to tanks of a specific age in a specific environmental setting.
2. **Formulate** appropriate compliance requirements based on review of monitoring, upgrading, and financial responsibility standards for a specific site.
3. **Determine** what federal and state regulations require be put on permits issued to tank facilities.
4. **Review and evaluate** an application for permitting a tank system and develop appropriate compliance alternatives based on the description provided.

Pre-Lab Outline

monitoring, registration, upgrading and insurance requirements for existing underground storage tank facilities. State again where that information is within the study material. It would be helpful to the students to go over a local operating permit, with conditions, so that they can see a sample final product.

Explain the assignment and the expectations for students to read carefully, and be thorough in the discussion of concerns.

Laboratory Exercise

1. Students will be divided into small working groups. They will be told that in this laboratory they are going to assume the role of the regulator, who must review an application and issue an appropriate permit. Each group will be given one of three facility applications. The facility application will tell about the facility, it's owner, and it's tank systems.

2. The students will review the application and formulate a permit consisting of some facility information, and all monitoring, upgrading, and financial coverage requirements as stipulated within the standards, for the particular facility.
3. The students within each group will pick a spokesperson who that will describe their permit and it's application to the class at the end of the lab.
4. The students can utilize available references in completing this lab.
5. The laboratory should be completed before the last 1/2 hour of class. The last half hour is to be utilized to discuss each group's approach.

Suggestions for Development and Presentation

As with lab 5, all students should review the application, and review references which apply to the particular facility, to establish permit requirements. The students may be redirected if they have drifted into a particular concern that is not relevant. Walk around and advise as needed.

Suggested applications for student evaluation can be found in the attachments for this lab.

References and Resources

As specified in lessons 5 and 6

Schedule and Assignments

The students will be divided up into the different groups, and each group will be given their permit application at the beginning of the class session. The project will be discussed and then each group allowed to work on the project during class time up to 1/2 hour of class completion. The different permit conditions will then be discussed.

UST Removal, Installation, and Release Investigations

Intent and Purpose

In this lesson the minimal requirements for tank removal, installation, and release detection will be covered.

Again the differences and similarities between the California and Federal requirements will be highlighted, by comparing the regulatory limitations for removal, installations and release investigations.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **List and compare** local, state and federal requirements for permanent closure of underground storage tank systems.
2. **Discuss** the minimal requirements for assessment of sites, the different methods specified within different jurisdictions, and some practical considerations while planning such assessment work.

3. **Describe** the different options that the local, state, and federal governments give to an UST facility owner that has discovered significant soil contamination and the different ways of interpreting “significance” of contamination, by the regulatory community.
4. **Identify** federal and state performance standards for new underground storage tank systems.
5. **Discuss** what an unauthorized release is, and the different options given to the owner, operator after they have discovered that an unauthorized release has occurred at their facility.
6. **Describe** the state “Pilot Program” and the federal “Lust” programs, as they relate to releases from underground storage tank facilities.
7. **Discuss** containment requirements and options for new underground storage tank installations.
8. **Identify** nationally recognized standards which provide minimal guidelines for equipment development and installation of equipment at underground storage tank facilities.

Lesson Outline

1. Historical overview of the development of new construction, and tank closure requirements (releases due to faulty construction, and tank explosions after unsafe removal or scrapping, etc.).
2. The investigations of releases. Give a historical overview (old investigations in which the both state and federal governments became involved).
3. Review basic provisions and requirements for removal and constructions at local, state, and federal levels, including:
 - Scope
 - Permitting
 - Safety
 - Release Investigations
 - Equipment Installation
 - Removal of Tanks and Piping Penalties for noncompliance
4. Describe the function of independent testing organizations.

Suggestions for Development and Presentation

Before beginning this session it would be helpful to survey the local agencies to determine how they are enforcing the state’s regulations for release investigations, installations, and removals at underground storage tank sites. A discussion with the contractors that must bid on the jobs and ensure that the requirements are being met will give

insight as to how difficult it is to keep up with the many changes within this field and the variation within geographical areas.

Begin by discussing the existing facility. Describe the ways that unauthorized releases can occur, and are discovered at such sites, and the damage that can be caused from such releases. The behavior of different materials within the soil matrix should be reviewed. Give a small overview of the makeup of the soil matrix, and the principles of contaminant transport for diesel, gasoline, and waste oil, and some solvents. Discuss the regulatory standards for release investigations and reporting, and highlight the variation from local to state to federal levels of government.

Discuss the pilot program, and the federal Lust program. Explain where the money comes from and who makes decisions on how it is spent. One way that an unauthorized release can be discovered is during the process of closure. The different closure requirements provided in federal, state regulations, and laws must be discussed.

Suggestions for Development and Presentation

The manner in which local agencies are enforcing various state laws and regulations will give the student an idea of the complexity that can be associated with planning the removal of underground storage tanks. Note that permitting, monitoring air emissions, cleaning tanks, scrapping tanks, etc. may require the oversight of various agencies.

Videos can provide the student with an appreciation for the problems generated when unauthorized releases cause significant environmental damage, such as ground water contamination of aquifers which were being used for domestic water supplies. There are also videos which provided recommended practices at removal and installation sites.

For new installations, slides can give the student a visual image of the tanks and piping installations not commonly viewed by those outside of the discipline. Be sure to concentrate on the proper handling and use of equipment to prevent unauthorized releases. Discuss the possible advantages and disadvantages of different equipment.

References and Resources

- *40 CFR*, Parts 280 and 281, Sections 280.20, 280.50, and 280.60
- *California Code of Regulations*, Title 23, Articles 3, 5, and 7.
- *Installation of Underground Petroleum Storage Systems*, 4th edition, Nov. 1987, American Petroleum Institute.
- *Recommended Practices for Installation of Underground Liquid Storage Systems*, Petroleum Equipment Institute, 1990.
- *Uniform Fire Code*, 1988 edition, Division VI—"Tank Storage Underground, Outside, or Under Buildings"
- *Oh No!—Petroleum Leaks and Spills What Do You Do?*, U.S. Environmental Protection Agency, Rockville,

MD.

- *Cleanup of Releases from Petroleum USTs: Selected Technologies*, U.S. Government Printing Office, Washington, D.C.
- *Tank Closure Without Tears: An Inspector's Safety Guide*, Video and Companion Booklet, New England Interstate Water Pollution Control Commission, Boston MA
- *Doing It Right - Installation For The Crew Who Do It*, Video, American Petroleum Institute, Washington DC, or Petroleum Equipment Institute, Tulsa Ok.
- *A Question of When: Tank Installation For Inspectors*, Video, National Fire Protection Association, Quincy MA
- *What Do We Have Here?: A Guide to Site Assessment at Closure*, Video and Companion Booklet, New England Interstate Water Pollution Control Commission, Boston MA.

Schedule and Assignments

This lesson is suggested to take three hours of classroom instruction.

Student reading assignments:

- Appropriate excerpts from governmental publications listed above, as well as pertinent sections of *CFR 40* and California laws and regulations.

UST Removal, Installation, Vapor Recovery, & Release Investigations

Intent and Purpose

The class will be divided into the same groups that worked together on the previous laboratory exercise. Each group will be told they represent either an owner, contractor, or regulator.

The same scenario will be given to each group. The groups will be asked to explain how they will approach various aspects of a new tank installation. This involves explaining what must be done and how they would do it. The scenario involves an owner that has been told that the underground storage tanks at his facility must meet some pretty expensive monitoring and upgrading requirements, and the insurance has refused to provide the liability coverage required. He has, therefore, decided to replace the facility tanks. A description of the facility is provided with a plot plan. Each group must develop a plan or approach to allow the facility owner to comply with the law.

Laboratory Objective

To successfully complete this exercise, the student will be able to:

Environmental Technology

1. **List** requirements for permanent closure of Underground Storage Tank Facilities.
2. **Develop** a plan to close, and construct an underground storage tank facility utilizing cost effective methodology.
3. **Plan** the new installation of a tank facility considering tank placement, and all compliance requirements, along with financial considerations.
4. **Evaluate** the information on a facility and make appropriate decisions regarding acceptable methods for replacement of Underground Storage Tanks.

Pre-Lab Outline

Review important aspects of lessons 5, 6, and 7, which may be utilized within this laboratory. State again where the relevant information may be obtained within the study material.

Explain the assignment and the expectations of each group.

Laboratory Exercise

1. The class will be divided into the same groups utilized within Lab #2, and the assignment will be discussed. Each group will be told that they represent either the tank owner, an installation/removal contractor, or a regulator. The groups will be given plot plans and discussion of a tank facility which needs to replace its underground storage tanks.

2. The students must review the information provided and plan, based on their assigned perspective, the removal and installation of the facility tanks.

3. The students can utilize references available but have only class time to formulate a written plan.

4. Each group will give a short presentation describing the group's approach before the class, before submitting it for a grade.

An underground storage tank facility is owned by Mr. Harry Stockton, who purchased the facility from a conglomerate after operating it for 10 years. He is currently owner and operator of the facility, with his sons. Harry used most of his life savings in order to purchase the facility; he therefore needs the most cost-effective new construction possible, since he will be borrowing the money to do the work. He also wants to be sure that the facility complies with all current state and federal standards and "anticipates" (to the extent possible) future requirements.

The facility information is provided below and on attached permit applications.

Facility Name: Harry's Garage
Facility Address: 1324 South Semore Street
Bakersfield, Calif.
Emergency Contact Person: Harry Stockton

Suggestions for Development and Presentation

Encourage the students to put themselves into the shoes of the assigned person. They are to approach the problem as if they were planning this with the limitations of each character assigned (for example: the regulator can advise, and process applications and inspect but cannot develop a bid package). Direct them to reference information if

Air Quality Issues

Instructor's Guide

Prepared By:

Ann Boyce
Bakersfield College
1801 Panorama Drive
Bakersfield, CA 93305
(805) 395-4552

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Module III— Air Quality Issues

Preface

This is the instructor's guide for a module entitled *Air Quality Issues*.

This module is part of *Hazardous Materials Management Applications*, a 4 unit lecture/laboratory core course in the EHMT Associate Degree and Certificate Program. The course is designed to provide students with hands-on instruction in the *applications* of major laws and regulations dealing with hazardous materials.

The course has been divided into three modules:

- Module I Right-to-Know Laws
- Module II Transportation & Underground Storage
- Module III Air Quality Issues

This modularization has been designed in such a way that the course can be taught as three separate “mini-courses.” Modules I and II are each 45 hours and therefore represent 1.5 lecture/lab units (7 lessons and 7 labs each account for 42 hours, the remaining three hours are for finals and other tests, etc.). Module III is 18 hours so can be taught as a 1 unit course.

Modularization will allow the maximum flexibility for individual colleges to meet both traditional educational goals **and** the immediate needs of local industry. This flexibility is evidenced by the following available options, since the modules can be used in whole or part for:

- Contract Education
- Community Service Classes
- Degree and Certificate Applicability

The lab exercises have also been designed with this flexibility in mind. Each lesson plan is for one week, or three hours, of lecture time. Associated with each lesson is a three hour lab exercise. Lab exercises can be taught either in a separate three hour lab period **or** can be alternated with lecture topics in an integrated course approach.

Module Description

This module is comprised of 18 lecture/laboratory hours covering the following aspects of federal and state air quality provisions:

- Introduction and History
- Requirements and Primacy of Statutes and Regulations
 - Federal
 - State
 - Local
- Compliance Strategies
- Regulatory Inspection & Enforcement Considerations
- Use of Resources and Other Sources of Assistance
- Recordkeeping and Reporting Requirements

Specific objectives are listed for each of the 3 lessons and 3 laboratory exercises described in this module.

Texts

Suggested Student Texts:

Excerpts of Federal and California Clean Air Acts

EPA publications and handouts, as desired by instructor (some are provided as attachments)

Local APCD or AQMD Rules and Regulations

Instructor Resources and References are described within this document.

Instructor Note

Note to Instructors: It is suggested that the instructor using this module read through **all** lessons and labs prior to starting the course. In this way, later concepts which are built on earlier activities can be better anticipated and planned for.

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1. State and Federal Clean Air Acts

Intent and Purpose

This lesson provides students with an overview of the California Clean Air Act and the Federal Clean Air Act Amendments. The accompanying laboratory exercise will give students the opportunity to compare and contrast these statutes.

Both federal and state laws are very broad in scope and have far-reaching impacts. Total coverage in one lesson and lab would be impossible, therefore, it is important for the instructor to stress major areas for coverage in this lesson. Student groups will get into the specifics during the laboratory exercise.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. *Describe* the overall goals of the federal Clean Air Act Amendments.
2. *Explain* important definitions contained in the federal CAA Amendments.
3. *Define* the scope of federal and state Clean Air Acts.
4. *Identify* major provisions of federal and state Clean Air Acts.

Lesson Outline

1. Review the history and background of the federal Clean Air Act Amendments.
2. Explain the overall goals and intent of the federal CAA Amendments.
3. Go over pertinent definitions used in the federal CAA Amendments, including:

- “Acid Deposition”
- “Air Toxics”
- “Aromatics”
- “Attainment Area”
- “Best Available Control Measure”
- “Clean Coal Technology”
- “Control Techniques Guideline”
- “Enhanced Inspection & Maintenance”
- “Federal Implementation Plan”
- “Gasoline Volatility”
- “Halogens”
- “Maximum Achievable Control Technology” (MACT)
- “Montreal Protocol”
- “Oxygenated Fuels”
- “Reasonably Available Control Measures” (RACM)
- “Reasonably Available Control Technology” (RACT)
- “Sanctions”

4. Outline scope and major provisions of both statutes (using summary informational sheets provided).

Suggestions for Development and Presentation

The EPA flyers and informational pamphlets provided in the attachments for this lesson provide information in outline form that can be simplified further to make effective overheads. The instructor should be careful not to get bogged down in details since the students will be looking more carefully at the actual text of portions of the statutes in the laboratory exercise.

The lecture should be confined to the scope and major impacts of these laws. Comparisons (federal vs. state) should not be made by the instructor since this is the essence of the laboratory exercise.

Resources and References

History of Standards:

- EPA *Environmental News* provided

Goals and Intent of The Clean Air Act Amendments of 1990:

- EPA attachments provided

Definitions:

- Actual text of statutes
- EPA "Glossary of Terms" attached

Scope and Major Provisions:

- EPA summary information attached
- Actual text of statutes

Schedule and Assignments

This lesson is suggested to take 3 hours of class time.

Students should be given summaries and pertinent information from handouts attached and text of statutes in order to follow along in this lecture.

Comparison of State and Federal Clean Air Acts

Intent and Purpose

This laboratory will require students to carefully compare and contrast provisions within state and federal Clean Air Acts. In doing this exercise, students will have an appreciation for the complexity of these laws as well as their differences in scope and approach. The ever changing regulatory environment as exemplified by these fairly recent laws will also reinforce the need to stay abreast of changes.

It would be very easy to make this exercise into a virtually unmanageable task given the intricacies of the laws. For this reason, it is very important to limit this activity to portions of the laws that will challenge but not totally frustrate the student.

Environmental Technology

Laboratory Objectives

To successfully complete this laboratory exercise, the student will be able to:

1. **Compare and contrast** provisions of the state and federal Clean Air Acts.
2. **Write** a clear summary of how the laws compare.

Pre-Lab Outline

1. The instructor should cover or review pertinent information from the laws at the beginning of the lab session, if needed.
2. The class should be divided into work groups of three or four students.
3. Work groups can be assigned the same exercise, or three or four different exercises can be developed and used.
4. In order to deal with the complexity of this exercise, student groups must be told that their reports on this comparison must deal with **only** three or four specific points within the topic. Otherwise, they would spend too much time in attempting to identify all points for comparison. Explain that the group must decide on the points they will work on.

Laboratory Outline

1. Student groups are given the assignment of preparing a written comparison of a specific aspect of state and federal Clean Air Acts.
2. Some examples are:
 - Compare Title I, Nonattainment Provisions, in the federal Clean Air Act with Nonattainment provisions in the California CAA (remember, select only 3-4 points for comparison).
 - Compare Title V, Operating Permit Provisions, in the federal Clean Air Act with Permit provisions in the California CAA.
 - Compare Title II, Mobile Source Provisions, in the federal Clean Air Act with Mobile Source provisions in the California CAA.
3. The federal CAA Amendments are nearly 800 pages long, so only pertinent sections should be provided to the students for this exercise.
4. An optional part of this exercise might be a class presentation by each group of about 5 minutes. They should cover the main points they chose to compare during this presentation. In this way, the rest of the class benefits from the work done in all areas.

Suggestions for Development and Presentation

The instructor may want to give an example comparison of an aspect of these two laws to further clarify what is expected from this exercise. In doing this, the instructor should be careful to choose an area that is not assigned to any group. An example of an area not covered in the three suggestions above is enforcement provisions.

This exercise is due at the beginning of the next lab session unless the instructor feels that more time is needed in the classroom for the groups to work together. Although optional, it is highly recommended that there be a class discussion of the findings of each group.

References and Resources

- Federal Clean Air Act Amendments
- California Clean Air Act

Schedule and Assignments

This laboratory exercise is suggested to take 3 hours of class time. It may also be necessary for students to work on this exercise outside of class. If needed, additional time during the next lab session can be devoted to completing this exercise.

2. Local Air Quality Rules**Intent and Purpose**

This lesson provides students with the opportunity to explore specific local rules for air pollution control.

Although districts must meet minimum requirements set up by CARB, there are unique variations throughout the state. This lesson and lab will utilize actual local rules and regulations to enable the student to become familiar with local approaches.

The instructor should be aware that when “APCD” is used in this write-up, it means either the local “Air Pollution Control District” or “Air Quality Management District”.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Describe** the local APCD’s responsibilities and organizational structure.
2. **Explain** important definitions contained in APCD rules.
3. **Define** the scope of local rules.
4. **Describe** the activities requiring APCD permits.
5. **List** activities that may require a risk assessment.

Lesson Outline

1. Review the history and background of the local APCD.
2. Explain the functions and responsibilities of the APCD as well as its organizational structure.
3. Go over pertinent definitions from local rules. Some examples are (there will be many more than this):
 - “Air Contaminants”
 - “Alteration”
 - “Atmosphere”
 - “Combustion Contaminants”
 - “Multiple Chamber Incineration”
 - “Open Outdoor Fire”
 - “Process Weight Per Hour”

Environmental Technology

4. Explain the handling by the APCD of confidential records, public disclosure, and enforcement (fines and penalties).
5. Describe monitoring and inspection procedures and timeframes.
6. Define the regulated universe (activities and facilities regulated vs. those that are not).
7. Describe activities and facilities that require permits.
8. Describe “risk assessment” as it pertains to air quality requirements. Explain when it may be required under local/state rules.

Suggestions for Development and Presentation

Many of the main topics in this lesson can be covered by a guest speaker from the local APCD. This person should be familiar with the history and evolution of the district as well as the rules and enforcement policies in force.

With the background provided in the first lesson and lab, students should be versed enough in the terminology and intent of air pollution control laws to ask interesting questions and benefit from a regulatory perspective. It would be helpful for students to have read some introductory material, for instance, general provisions of local rules, **prior** to attending this lecture in order to derive the greatest benefit.

If a guest lecturer is used, the instructor needs to be sure all necessary objectives are covered.

Resources and References

- Local APCD Rules and Regulations (will vary from area to area)

Schedule and Assignments

This lesson is suggested to take 3 hours of class time.

- Students should read all introductory information in local rules covering objectives for this unit.

1. Comparison of State and Federal Clean Air Acts

Intent and Purpose

This laboratory will require students to carefully compare and contrast provisions within state and federal Clean Air Acts. In doing this exercise, students will have an appreciation for the complexity of these laws as well as their differences in scope and approach. The ever changing regulatory environment as exemplified by these fairly recent laws will also reinforce the need to stay abreast of changes.

It would be very easy to make this exercise into a virtually unmanageable task given the intricacies of the laws. For this reason, it is very important to limit this activity to portions of the laws that will challenge but not totally frustrate the student.

Laboratory Objectives

To successfully complete this laboratory exercise, the student will be able to:

1. *Compare and contrast* provisions of the state and federal Clean Air Acts.

2. **Write** a clear summary of how the laws compare.

Pre-Lab Outline

1. The instructor should cover or review pertinent information from the laws at the beginning of the lab session, if needed.
2. The class should be divided into work groups of three or four students.
3. Work groups can be assigned the same exercise, or three or four different exercises can be developed and used.
4. In order to deal with the complexity of this exercise, student groups must be told that their reports on this comparison must deal with **only** three or four specific points within the topic. Otherwise, they would spend too much time in attempting to identify all points for comparison. Explain that the group must decide on the points they will work on.

Laboratory Outline

1. Student groups are given the assignment of preparing a written comparison of a specific aspect of state and federal Clean Air Acts.
2. Some examples are:
 - Compare Title I, Nonattainment Provisions, in the federal Clean Air Act with Nonattainment provisions in the California CAA (remember, select only 3-4 points for comparison).
 - Compare Title V, Operating Permit Provisions, in the federal Clean Air Act with Permit provisions in the California CAA.
 - Compare Title II, Mobile Source Provisions, in the federal Clean Air Act with Mobile Source provisions in the California CAA.
3. The federal CAA Amendments are nearly 800 pages long, so only pertinent sections should be provided to the students for this exercise.
4. An optional part of this exercise might be a class presentation by each group of about 5 minutes. They should cover the main points they chose to compare during this presentation. In this way, the rest of the class benefits from the work done in all areas.

Suggestions for Development and Presentation

The instructor may want to give an example comparison of an aspect of these two laws to further clarify what is expected from this exercise. In doing this, the instructor should be careful to choose an area that is not assigned to any group. An example of an area not covered in the three suggestions above is enforcement provisions.

This exercise is due at the beginning of the next lab session unless the instructor feels that more time is needed in the classroom for the groups to work together. Although optional, it is highly recommended that there be a class discussion of the findings of each group.

References and Resources

- Federal Clean Air Act Amendments
- California Clean Air Act

Schedule and Assignments

This laboratory exercise is suggested to take 3 hours of class time. It may also be necessary for students to work on this exercise outside of class. If needed, additional time during the next lab session can be devoted to completing this exercise.

2. Local Air Quality Rules

Intent and Purpose

This laboratory should cover a “hands-on” aspect of the local rules, such as, obtaining a “Permit to Operate” or “Authority to Construct.”

Since local district emphasis and rules vary throughout the state, it is important to work with local APCD officials to develop the specific laboratory exercise. It should relate to permitting or another activity that focuses on application of the rules and provides a better understanding for the student of the mechanics of compliance.

Laboratory Objectives

The instructor, in cooperation with local APCD, should develop appropriate objectives based on the learning experience desired for the student.

Laboratory Outline

Suggestions for this exercise include:

1. Evaluating scenarios for permitting requirements.
2. Filling out portions of a permit application requiring calculation or compilation, given information from a scenario.
3. Detailing violations of permit conditions from a hypothetical scenario.

Suggestions for Development and Presentation

Working with local regulatory staff will provide the local perspective needed in this activity. Enforcement staff will also have many useful case studies that can become part of this exercise.

With the background provided in the first lesson and lab, students should be versed enough in the terminology and intent of air pollution control laws to ask interesting questions and benefit from a regulatory perspective. It would be helpful for students to have read some introductory material, for instance, general provisions of local rules, {prior} to attending this lecture in order to derive the greatest benefit.

If a guest lecturer is used, the instructor needs to be sure all necessary objectives are covered.

References and Resources

- Local APCD Rules and Regulations (will vary from area to area)

Schedule and Assignments

This laboratory exercise is suggested to take 3 hours of class time. It may also be necessary for students to work on this exercise outside of class.

3. Special Topics in Air Quality

Intent and Purpose

This lesson will address topics in Air Quality that are of special concern in the area in which the class is offered as

well as additional topics of general concern.

The instructor is given latitude in choosing appropriate topics for this lesson. Some suggestions and recommendations are described.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Describe** attainment and non-attainment air pollutants, their sources, and controls in the district.
2. **Explain** how asbestos is regulated from an air quality standpoint.
3. **Describe** what is being done to resolve a troublesome air quality problem in your area.
4. **List** two basic requirements of the “Air Toxics ‘Hot Spots’” legislations and two local industries that may be affected.

Other objectives should be developed, as needed, to cover materials to be presented.

Lesson Outline

Although the lesson outline is flexible, there are a number of topics that should be covered:

1. The EHMT curriculum does not have much information on asbestos that is presented to the student. It is, therefore, advisable to present basic facts about what it is and where it is found. This information can be readily tied-in to air quality standards.
2. “Air Toxics ‘Hot Spots’” legislation should be covered with a discussion of the status of local prioritization.
3. Other, local problems such as ozone and PM-10 should be discussed. Include in the discussion actions APCD has taken or is contemplating taking to resolve the situation.
4. District Attainment/Non-Attainment Plans should be highlighted.

Suggestions for Development and Presentation

APCD staff and local industry representatives or political figures would be helpful in giving students their perspective on local concerns.

Many districts have regular newsletters from which policy directions and proposed rulemaking information can be obtained.

Resources and References

- Local APCD Contacts and Newsletters
- Political figures and members of industry that are involved in air quality issues

Schedule and Assignments

This lesson is suggested to take 3 hours of class time.

3. Air Quality Compliance Demonstration/Field Trip

Hazardous Waste Generator Compliance

Instructor's Guide

Prepared By:

Stephen R. Onstot, Esq.
Burke, Williams, & Sorensen
611 West Sixth Street, Suite 2500
Los Angeles, CA 90017
(213) 236-0600

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Preface

This is the instructor's guide for a module entitled ***Hazardous Waste Generator Compliance***.

This module is part of ***Hazardous Waste Management Applications***, a 4 unit lecture/laboratory core course in the EHMT Associate Degree and Certificate Program. The course is designed to provide students with hands-on instruction in the *applications* of major laws and regulations dealing with hazardous waste management.

The course has been divided into three modules:

- **Module I Hazardous Waste Generator Compliance**
- **Module II RCRA and Superfund**
- **Module III Sampling and Analysis**

This modularization has been designed in such a way that the course can be taught as three separate "mini-courses." Modules I and III are each 45 hours and therefore represent 1.5 lecture/lab units. Module II is 18 hours so can be taught as a 1 unit course.

Modularization will allow the maximum flexibility for individual colleges to meet both traditional educational goals **and** the immediate needs of local industry. This flexibility is evidenced by the following available options, since the modules can be used in whole or part for:

- **Contract Education**
- **Community Service Classes**
- **Degree and Certificate Applicability**

The lab exercises have also been designed with this flexibility in mind. Each lesson plan states the recommended hours of lecture or laboratory time. Lab exercises can be taught either in separate lab periods **or** can be alternated with lecture topics in an integrated course approach.

Hazardous Waste Generator Compliance

Module Description

This module is comprised of 45 lecture/laboratory hours covering the following aspects of Federal and California hazardous waste generator compliance:

- Overview and Identification
- Regulatory Requirements On-site and Off-site
- How to Conduct a Hazardous Waste Audit
- How to Properly Transport Hazardous Wastes
- How to Store and Lab-Pack Hazardous Wastes
- Marking, Labeling, and Placarding
- Preparing the Uniform Hazardous Waste Manifest
- Liability Issues
- Use of Resources and References
- Recordkeeping and Reporting Requirements

Specific objectives are listed for each of the 5 lessons and 5 laboratory exercises described in this module.

Texts

Suggested Student Texts:

Dufour, James T., *Hazardous Waste Management Handbook*, California Chamber of Commerce, most recent edition.

Instructor Resources and References are described within this document.

Instructor Note

Note to Instructors: It is suggested that the instructor using this module read through **all** lessons and labs prior to starting the course. In this way, later concepts which are built on earlier activities can be better anticipated and planned for.

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Overview and Identification of Hazardous Wastes

Intent and Purpose

In this lesson, the concept of a “hazardous waste” is introduced and differentiated from a “hazardous substance.” Based on this distinction, a regulatory overview is presented which outlines the hazardous waste regulatory structure, major regulatory agencies and their jurisdictions, and landmark legislation in the hazardous waste area.

Lesson Objectives

Successful completion of this module will enable the student to:

1. **Distinguish** between a “hazardous substance,” a “hazardous material,” and a “hazardous waste.”
2. **Determine** when a “substance” becomes a “waste.”
3. **Distinguish** between “RCRA hazardous wastes,” “California hazardous wastes,” “special wastes,” “designated wastes,” and “extremely hazardous wastes.”
4. **Know** the difference between a “statute” and a “regulation.”
5. **Understand** the historical development of hazardous waste regulation at the federal level.
6. **Understand** the historical development of hazardous waste regulation at the state level.
7. **Understand** the historical development of hazardous waste regulation at the local level.
8. **Understand** the jurisdiction of federal, state, and local hazardous waste regulatory agencies.
9. **Identify** major federal and state hazardous waste statutes.
10. **Identify** major federal and state hazardous waste regulations.
11. **Understand** which industry groups generate the most hazardous wastes.
12. **Understand** what types of hazardous wastes are typically generated by each major industry group.
13. **Know** the federal and state system for identification of hazardous waste generators.
14. **Recognize** conditions which may require DHS, NPDES, Air Emissions, or local permits.
15. **Understand** the concept of “cradle-to-grave” liability for hazardous waste generators.

Lesson Outline

1. Introduce the instructor and administration of the 5 lesson module.
2. Explain that the module is structured in a “cradle-to-grave” manner, tracking hazardous waste management from generation through disposal.

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3. Introduce the textbook, *Hazardous Waste Management Handbook*, published by the California Chamber of Commerce.
 4. Introduce the concept of a “waste.” (Health and Safety Code (H&SC) 25124).
 5. Introduce, and explain the difference between a “hazardous substance” (H&SC 25316), a “hazardous material” (49 CFR 171.8), and a “hazardous waste” (H&SC 25177).
 6. Introduce, and explain the difference between, a “RCRA hazardous waste” (H&SC 25120.2), a “California (non-RCRA) hazardous waste” (H&SC 25117.9), an “extremely hazardous waste” (H&SC 25115), a “designated waste” (26 CCR 23-2522), a “restricted hazardous waste” (H&SC 25122.7), and a “special waste” (26 CCR 22-661950). Note: The above terms do not have universal definitions throughout the statutes and regulations.
 7. Explain the criteria for identification of hazardous and extremely hazardous wastes (26 CCR 22-66305, 66393 et seq.). *Note:* The goal here is for students to have an *awareness* of the hazardous waste classification criteria—not an expertise; therefore, detailed explanation of the classification process and criteria is discouraged.
- Once students are taught how to determine if a waste is hazardous, the next step is to teach them how to manage a waste determined to be hazardous. The remainder of this lesson, and indeed the entire module, is devoted to achieving this goal.
8. Introduce local responsibilities in hazardous waste management, especially in the performance of generator inspections.
 9. Discuss other federal, state, and local agencies which may become involved in hazardous waste management. For example: Department of Transportation, OSHA, Department of Defense, Department of Fish and Game, Department of Food and Agriculture, Integrated Waste Management Board, and the Highway Patrol. Ask students to identify additional agencies which may have an interest in hazardous waste management.
 10. Lead a discussion of overlapping jurisdictions. This discussion should include the federal “pre-emption doctrine” whereby federal statutes are deemed to either 1) pre-empt the entire field, thereby allowing for no state regulation, or 2) set minimum standards, thereby allowing states to be more stringent than the federal government. The discussion should also include a state’s general “police power” to protect the health and welfare of its citizens. Finally, the discussion should include “commerce clause” provisions whereby states cannot enact laws to inhibit interstate commerce (i.e. the need for national uniform standards in areas such as transportation).
 11. Discuss the advantages and disadvantages of having several agencies regulate hazardous waste management. Be sure to view the issues from the following perspectives: a hazardous waste generator; a proponent of a new hazardous waste treatment or disposal facility; a regulator; a manufacturing company considering re-locating to California; a local elected official; and an environmentalist.
 12. Identify the major hazardous-waste producing industry groups. (See textbook, page 4)
 13. Discuss major hazardous waste streams associated with such industry groups. (See textbook, page 18)
 14. Introduce the systematic approach for determining if a business generates a hazardous waste. (See textbook, page 21)
 15. Explain RCRA: the Act itself, its supporting regulations, Subtitle D (solid waste), Subtitle C (hazardous waste), and Subtitle I (underground storage tanks).

16.Explain the concept of EPA ID Numbers and why they are important.

17.Explain the “cradle to grave” management and liability system of RCRA.

18.Explain the general conditions which necessitate the need for generators to obtain DHS storage permits or variances, NPDES permits, Air Emissions permits, and local permits such as Fire Department approvals, building permits, and land use approvals.

19.Explain the concept of the EPA Hazardous Waste Activity Notifi

20.Explain the concept of an Extremely Hazardous Waste permit, how it differs from a facility permit, and when such permit is required.

Suggestions for Development and Presentation

Present the relationship between statutes, regulations, and regulatory agencies graphically.

Work through a sample problem involving the determination of whether a waste is to be classified as “hazardous.” This may also be used to introduce the laboratory session corresponding to this lesson.

Work through a sample problem involving the identification of regulatory agencies and their jurisdictions. This may also be used to introduce the laboratory session corresponding to this lesson.

The key concept to convey in this lesson is “what does EPA and DHS expect from hazardous waste generators?”

The instructor also may wish to work through a sample Extremely Hazardous Waste permit application and/or an EPA Hazardous Waste Activity notification form. This may also be used to introduce the laboratory session corresponding to this lesson.

References and Resources

For this lesson, the instructor should refer to historical and regulatory background information described in Eastern Iowa’s HMTRI, *Course #HMT-100*, Lessons 1 and 2, and *HMT-200*, Lessons 1 and 5.

Attached Memorandum of Understanding between the State Department of Health Services and the State Water Resources Control Board.

Attached diagrams of statutes, regulations, and regulatory agencies.

Attached sample problem illustrating the hazardous waste determination process.

Attached sample problem illustrating the inter-relationship and jurisdictions of regulatory agencies.

Attached portions of EPA’s *RCRA Orientation Manual*, January, 1986.
Small Quantity Generator Handbook, American HAZMAT, San Diego, 1990.

Attached sample of an extremely Hazardous Waste permit application.

Attached sample EPA Notification of Hazardous Waste Activity form.

Schedule and Assignments

This lesson is designed for 5 hours of lecture.

Students should review their notes of the lecture in preparation for the laboratory. The attached “LABORATORY I” should be reproduced and distributed to each student at the beginning of the laboratory period, and collected when the student has completed all exercises.

Students should read pages 1-36, 45-62 and 89-94 of the textbook in preparation for Lesson 2.

Determination of Wastes, Hazardous Wastes, and Regulatory Agencies

Intent and Purpose

This laboratory session has three parts. In Part I, you will analyze various fact patterns to determine if the materials discussed are likely to be classified as “wastes.” In Part II, you will determine if various wastes are considered “hazardous” pursuant to federal and state regulations. In Part III, you will analyze various scenarios to determine which governmental agencies have jurisdiction over the hazardous waste problems posed in each fact pattern.

Laboratory Objectives

Successful completion of this laboratory exercise will enable the student to:

1. Determine if a substance meets the definition of a “waste” under California regulations.
2. Determine if a waste is hazardous pursuant to federal and state regulations.
3. Understand the jurisdictions of major federal, state, and local agencies involved with regulation of hazardous wastes.

Laboratory Exercise

You have four hours to complete these laboratory exercises. You may refer to the attached reference materials, the course textbook, and any other references you deem appropriate. Carefully follow the instructions for each part of the laboratory and record all of your answers on the attached answer sheet.

Part I, Determination of “Wastes” (60 minutes)

You have just joined Baker Manufacturing Company as a Safety Technician, and your first assignment is to inspect the warehouse to identify materials which are more likely than not “wastes” as defined by section 25122 of the Health and Safety Code.

Below is a list of materials which you found during your inspection. On your answer sheet, indicate whether each listed material is more likely than not a “waste,” and, if it is a “waste,” explain why. If the material is not likely a “waste,” then so indicate.

Examples:

“ a pile of old newspapers”

answer: Waste, no intended use, recyclable

“ a full bottle of hand soap on the sink”

answer: Not a Waste

Exercises:

1. “a small pile of spilled sugar”
2. “a small pile of spilled paper clips”
3. “a box of old doorknobs labeled ‘Save for pickup by John’s Salvage Company’”
4. “a box of old doorknobs labeled ‘Save for pickup by John’s Salvage Company on or before August 1, 1988’”
5. “a box of old broken doorknobs labeled ‘Save for pickup by John’s Salvage Company on or before Christmas, 1991’”
6. “a full bottle of aspirin labeled ‘Use on or before July 1, 1990’”
7. “two pounds of silver solder (although Baker Manufacturing has used only tin solder for the past 10 years and does not anticipate using silver solder in the future)
8. “unlabeled antique colored glass bottles containing unknown liquid substances
9. “a cardboard box of grass seed with extensive water stains”
10. “a five gallon can of used motor oil”
11. “three fire extinguishers which were replaced last month by three new ones”
12. “a box of empty aluminum beer and soda cans labeled ‘To support our foster child’”
13. “a box labeled ‘Discard’ containing four brand new (although slightly flawed) crystal vases manufactured by Baker Manufacturing Co. with a value of about \$200. Baker Manufacturing Co. has a policy of not selling vases which have imperfections
14. “unlabeled containers of food found in a refrigerator used to store heat-sensitive chemicals but frequently used by employees for storage of food”
15. “four reams of company letterhead with the wrong address”
16. “a key ring with 15 unmarked keys on it found in an old briefcase used by a former company salesman 10 years ago”
17. “a file cabinet containing duplicate company income tax records from 1985-1988”

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18. “window washing equipment, even though the company has contracted out for such service over 5 years ago”

19. “a box of safety goggles of a type which few people use since they are uncomfortable, but nonetheless meet OSHA safety requirements”

20. “ten slightly damaged 100-pound sacks of sand used by the company to manufacture crystal”

Part II, Determining if a Waste is Hazardous (90 minutes)

You are a Hazardous Waste Classification Technician with the State Department of Health Services. Your duties include screening chemical wastes to make a preliminary assessment as to whether they are hazardous pursuant to state and/or federal regulations.

Below is a list of materials already classified as “wastes” by other technicians. On your answer sheet, indicate all hazardous characteristics which are applicable to the listed wastes.

Example:

RCRA 26 CCR

Waste listed listed Flammable Corrosive Reactive Toxic Persistent

acetone X X X

Note: The federal and state characteristics of a hazardous waste are very similar. In these exercises, only consider the five state characteristics listed above.

Exercises:

1. Fluorine

2. Carbon disulfide

3. Trichloroethylene (STLC=220.6)

4. Glue containing 5% vinyl chloride

5. p-nitrochlorobenzene

6. Concentrated hydrochloric acid

7. Phosphorus trichloride

8. Titanium dioxide

9. Bleach (hydrogen peroxide)

10. Window washing solution of dishwasher soap (sodium hydroxide) and vinegar (5% acetic acid)

Part III, Determination of Appropriate Regulatory Agencies (90 minutes)

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Below are five scenarios involving hazardous waste management. Analyze each scenario and, on your answer sheet, list all governmental (including regulatory) agencies which reasonably may have some involvement with the management of hazardous wastes as set forth in the scenario. Briefly explain why such agencies should be involved and which agency, if any, should be considered “lead agency” and why.

Example:

In the remediation of a leaking underground gasoline tank requiring aeration of contaminated soil, the county department of public works will probably be the lead agency since it is delegated underground storage tank permitting and cleanup authority by the RWQCB. The APCD will also be involved since aeration involves emitting gasoline vapors to the air. If a potential explosion or fire hazard is present, the local fire department will also be involved.

Exercises:

1. ABC Electroplating has been in operation for about 15 years, and it is the process of remodeling its chemical storage area. When the demolition contractor removed the concrete flooring in the cyanide storage shed, it noticed discolored soil.
2. Robinson Research Company tests for purification of various types of industrial gases. One day, a technician for Robinson was changing chlorine gas cylinders and broke a control valve, thereby releasing pressure in the cylinder and allowing chlorine gas to escape into the laboratory.
3. During grading at a new construction site near the municipal water well, ten empty 55-gallon drums labeled “Concentrated pesticides” were uncovered.
4. High levels of lead were discovered on a remote portion of a U.S. Army base which is now used as a wildlife refuge for the double-crested pelican.
5. In the 1920’s, formaldehyde was used to embalm human bodies before they were placed in wooden caskets for burial. Recently, it was learned that over the past several years the bodies and caskets had decomposed, but the formaldehyde was, and still is, migrating through the soil into the groundwater which is used by the San Joaquin Valley farmers to irrigate their crops.

When you have completed the above exercises, please turn in your answer sheet to the instructor.

Laboratory 1 Answer Sheet

Part I: Waste

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.
- 11.
- 12.
- 13.
- 14.
- 15.
- 16.
- 17.
- 18.
- 19.
- 20.

Laboratory 1, Part II: Hazardous Wastes

W= waste RCRA= RCRA listed 26 CCR= 26 CCR listed
F= flammable C= Corrosive R= Reactive T=Toxic
P= Persistent

<u>Waste</u>	RCRA 26 CCR						
	<u>listed</u>	<u>listed</u>	<u>F</u>	<u>C</u>	<u>R</u>	<u>T</u>	<u>P</u>
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							

Part III: Governmental Agencies

- 1.
- 2.
- 3.
- 4.
- 5.

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Laboratory 1, Instructor's Guide To Answers

Part I Wastes

The concept explored in this laboratory section is the difficulty in determining when a material becomes a waste pursuant to H & SC 25122. The laboratory instructions help to facilitate a student's analysis since the "more likely than not" standard is employed.

1. Waste. Spilled food is not likely to be used and is likely to be discarded.
 2. Not a waste. Paper clips are often spilled, and they are usually picked up and reused.
 3. Not a waste. The doorknobs are still usable.
 4. Waste. The doorknobs were intended to be saved until August, 1988. Since so much time has passed since August, 1988, it is more likely than not that the box of doorknobs can be now classified as a waste.
 5. Waste. Even though there is no present intent to discard, the doorknobs are broken and, therefore, unusable.
 6. Not a waste. Although the aspirin has passed its "use by" date, there are no facts indicating an intent to discard.
 7. Not a waste. Just because Baker does not use silver solder in its operations does not mean that Baker has no use for silver solder. Silver is a precious metal which is rarely, if ever, intentionally discarded. Coupled with the fact that the silver solder is apparently still usable by someone, it is more likely than not that the silver solder is an asset as opposed to a waste.
 8. Waste. The antique bottles probably have asset value, but the unknown chemicals are likely to have no beneficial use. Further, the bottles are unlabeled. Thus, to take advantage of the bottles' asset value, the liquids in those bottles must be removed. Since the liquids are unknown, they must be managed as hazardous wastes. The costs of separating the liquids from the bottles, handling them as hazardous wastes and properly cleaning the bottles are probably greater than the antique value of the bottles.
 9. Waste. Grass seed has a fairly short shelf life, and extensive water damage indicates that the seed was subjected to moisture which would severely reduce the germination rate. Since it would be difficult to separate the moisture-exposed seed from the "dry seed," the entire box probably has little or no use.
 10. Waste. The oil is used, therefore it likely has no use and is probably going to be discarded or recycled.
 11. Not a waste. There are no facts indicating that there is no use for the old fire extinguishers. If they are still in good operating condition, they still have a use. It is not likely that emergency response equipment in good working order would be discarded.
- Lab Exercise (Continued)
12. Waste. The cans probably have no functional use, but they are being used for their monetary value as recyclable materials. Such analysis does not take the cans out of the "waste" category, for despite their recycling potential, the cans are no longer suitable for their intended use, and, if recycling was not available, the cans would be discarded.
 13. Waste. Clearly the vases are to be discarded, and the fact that the vases may have use to others, the one in control of the vases (Baker) view them as having no use (i.e. they are not saleable).

14. Waste. Improperly labeled materials which pose a health threat are wastes.
15. Waste. Most businesses would regard misprinted letterhead unusable and, therefore, it is likely to be discarded.
16. Waste. The importance, if any, of the keys would have been recognized shortly after they were lost, and the situation remedied by duplicate keys, changed locks, etc..
17. Not a waste. Recent income tax records have great importance and are not likely to be discarded.
18. Not a waste. The materials are still usable and no intended present use is not the same as an intent to discard.
19. Not a waste. The goggles are still useful and some people continue to use them.
20. Not a waste. Despite being slightly damaged, it appears that the bags of sand are still usable as a raw material.

Part II, Hazardous Wastes

The Instructor should ensure that students refer to Appendix D of the textbook in completing these exercises.

1. RCRA and 26 CCR listed, C,R,T
2. RCRA and 26 CCR listed, F,T
3. RCRA and 26 CCR listed, F,T,P
4. RCRA and 26 CCR listed, F,T
5. 26 CCR listed, T
6. 26 CCR listed, C,R,T
7. 26 CCR listed, C,R,T
8. not hazardous
9. 26 CCR listed, F,C,R,T
10. 26 CCR listed, F,C,T; but note dilution with water and the concept of mixing

Part III, Regulatory Jurisdiction

1. Local Building Department, DHS, RWQCB, EPA
2. OSHA, Fire Department, APCD, DHS, EPA
3. Local Building Department, RWQCB, DHS, EPA, County Agriculture Commissioner
4. Department of Defense, appropriate wildlife protection agency (i.e. Calif. Department of Fish and Game), EPA, DHS, RWQCB

5. Department of Consumer Affairs, Department of Food and Agriculture, County Agriculture Commissioner, DHS, RWQCB, EPA

Suggestions for Development and Presentation

During this laboratory session, students will quickly learn that a “cookbook” approach to hazardous waste management usually does not work because each situation produces its own unique factual scenario which dictates the regulatory framework under which a generator must operate. Therefore, be patient as the students work through these exercises and encourage creative thought and analysis as opposed to trying to find “the” right answer to the problems.

References and Resources

Title 40, Code of Federal Regulations
Title 26, California Code of Regulations

Schedule and Assignments

Lesson 1 should be completed prior to this Laboratory Session. This Laboratory Session is intended to take 4 hours.

On-Site Hazardous Waste Management

Intent and Purpose

In this lesson, the on-site management of hazardous waste is covered. A wide variety of topics are presented including: storage requirements, compatibility of wastes, employee training and safety, waste reduction, recordkeeping, and recycling.

Lesson Objectives

Successful completion of this lesson will enable the student to:

1. **Understand** the difference between accumulating hazardous wastes and storing hazardous wastes.
2. **Understand** what a “small quantity generator” is, and how they may be regulated differently from “large quantity generators.”
3. **Handle, accumulate, and store** hazardous wastes on-site.
4. **Understand** which hazardous waste groups are compatible and which are incompatible.
5. **Recognize** the need for specialized safety and emergency response training for those who manage hazardous wastes.
6. **Understand** the recordkeeping obligations of hazardous waste generators.
7. **Understand** the hazardous waste generator’s obligation to reduce his/her hazardous waste.

Lesson Outline

1. Explain “accumulating wastes” and “storing wastes” and differentiate between the two concepts.
2. Explain the differences between a large and a small quantity generator and the regulations applicable to each.
3. Explain the necessity to segregate wastes which are incompatible.
4. Explain *and emphasize* which major waste groups are incompatible.
5. Demonstrate a procedure for determining whether wastes are compatible. The ASTM method is widely recognized and is attached hereto.
6. Explain proper procedures for handling empty containers.
7. Provide an overview of personnel training requirements in the areas of hazardous waste management, emergency response, and safety. Extensive discussion in these areas is not necessary since these requirements will be covered more extensively in other courses in the EHMT program.
8. Explain generator recordkeeping requirements with emphasis on the bi-annual report.
9. Explain the generator’s obligation to employ waste reduction strategies.
10. Lead a discussion on the concepts of re-use and recycle, and identify wastes which are often recycled.

Suggestions for Development and Presentation

Perform a demonstration as to reactions caused by mixing incompatible chemicals.

Work through preparation of a bi-annual report. This may also be used to introduce the laboratory session corresponding to this lesson.

References and Resources

Small Quantity Generator Handbook, American HAZMAT, San Diego, CA.

HMTRI, *Course #HMT-200*, Lesson 2, “Recordkeeping and Reporting.”

Schedule and Assignments

This lesson is designed for 3 hours of lecture.

Students should read pages 63-76 of the textbook in preparation for the Lesson 3.

Notification of Hazardous Waste Activity & Performing Compliance Audits

Intent and Purpose

This laboratory session has two parts. In Part I, you will complete three problems involving completion of Notification of Hazardous Waste Activity forms. In Part II, you will perform a Compliance Audit for hazardous waste generation.

Laboratory Objectives

Upon completion of this laboratory, the student will be able to successfully complete the following:

1. A Notification of Hazardous Waste Activity.
2. A Compliance Audit for hazardous waste generation.

Laboratory Exercise

Carefully follow the instructions for each problem below and be sure to turn in all required papers prior to leaving the laboratory.

Part I, Notification of Hazardous Waste Activity

1. You have just purchased Dandy's Dry cleaners. The "plant" where the dry cleaning is performed is at 817 Charles St., El Monte CA 94317, but all administration of the business is conducted at 2121 N. Broderick Way, Long Beach CA 91877 where the retail outlet is located.

You decide to hire a manager for the plant (Bob Jones) so you are able to concentrate on running the business from your Long Beach office.

Dandy Dry cleaners is a typical dry cleaning operation, using tetrachloroethylene (also known as perchloroethylene or "perc") to clean clothes. Although the "perc" is reused as much as possible, Dandy Dry cleaners still produces about 110 gallons of spent "perc" per month which is transported for recycling by Doodle Brothers Trucking every month. After telephoning DHS, you verify that Doodle Brothers is a registered hazardous waste hauler in California.

Dandy's previous owner told you that her EPA ID Number is CAD 893147689, and your attorney advises you that you must complete a Notification of Hazardous Waste Activity form and send it to EPA. The density of spent "perc" is 1.63, and .26 gallons= 1 liter. Complete the required form.

2. You are the manager of Cork County's Public Works warehouse located at 123 So. Street, Spilleville, CA 94536. In cleaning out the warehouse, you find a can of nickel sulfate which weighs about 50 pounds and can be considered a waste material. Complete the proper notification form.
3. You are an environmental consultant to Fort Toxic, a U.S. Army base in central California under the command of Colonel Daniel Lee. Your investigation of hazardous waste generation on the base yields the following:

formaldehyde, 40 gallons/month (density = 1.00)

chloroform, 110 gallons/year (density= 1.50)

lead chromate, 80 pounds/month (density= 6.30)

phosgene, 20 gallons/month (density= 1.37)

picric acid, 70 gallons/month (density= 1.76)

Fort Toxic does not have an EPA ID Number. Complete the proper notification forms.

Part II, Compliance Audit

Procedure:

Step 1 - Inventory all materials

Step 2 -Identify all hazardous materials

Step 3 -Identify all hazardous wastes

Step 4 -Inventory all hazardous wastes

<u>i.e.</u>	<u>Volume</u> <u>Waste</u>	<u>Characteristic</u>	<u>Rate of</u> <u>Generation</u>	<u>On Hand</u>
	Toluene/ grease mixture	F	10 gal/wk	85 gallons

Step 5 -Calculate accumulation rate of each hazardous waste

i.e. 10 gal/wk = 90 lbs/wk
 = 360 lbs/month
 = 360 x 3 = 1080 lbs every 3 months (90 days)

Step 6 -Prepare Hazardous Waste Management Matrix

	<u>Storage</u> <u>Waste</u>	<u>Storage</u> <u>Container</u>	<u>Area</u>	<u>Ship</u> <u>Inspect</u>	<u>Shipped</u> <u>By</u>	<u>Manifest</u> <u>On</u>	<u>Number</u>
i.e.	Toluene/ grease	55 gallon drum	A	every Monday	3/15/91	3/14/91	12345

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Exercise:

Perform a Compliance Audit for a business using/generating the following materials/wastes:

<u>Materials</u>	<u>Quantity</u>
Talc	2000 tons/month
Titanium Dioxide	600 lbs/month
Lead Chromate	185 lbs/week
Copper sulfate	30 lbs/year
Isopropyl alcohol	22,000 gal/yr
Toluene	22,000 gal/yr
Mercury	7 gal/yr
Motor oil	32 qt/yr
WD-40	6-12 oz cans/yr
Bleach	20 gal/month
Household ammonia	40 gal/month
Anti-Freeze	10 gal/yr
Sulfuric acid	7 gal/yr

<u>Wastes</u>	<u>Quantity</u>
1. Off-spec titanium dioxide	20 lbs/yr
2. Paint samples: lead/talc/toluene	15 gal/yr
3. Paint samples: copper sulfate/talc/isopropyl alcohol	40 gal/yr
4. Off-spec paint = lead/talc/toluene	700 gallons

Suggestions for Development and Presentation

References and Resources

Schedule and Assignments

The attached materials should be given to students for review prior to Laboratory Session 3.

Student Preparation

An immense amount of time will be saved if you familiarize yourself with requirements in the above areas.

Laboratory Preparation

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Transporting Hazardous Waste

Intent and Purpose

In this lesson, students will be introduced to requirements regarding the transportation of hazardous waste. In particular, packaging, labeling, and marking regulations are discussed as well as the importance of choosing a qualified hazardous waste transporter. The lecture concludes with instruction on the purpose and use of the hazardous waste manifest.

Lesson Objectives

Successful completion of this lesson will enable the student to:

1. ***Properly prepare*** hazardous wastes for shipment by following federal and state labeling, packaging, and marking regulations.
2. ***Choose*** a certified hazardous waste hauler.
3. ***Select*** an appropriate treatment, storage, or disposal facility to receive the hazardous waste.
4. ***Recognize*** when a hazardous waste manifest is required.

Lesson Outline

1. Explain and demonstrate Department of Transportation packaging regulations. (49 CFR, Parts 173, 178, and 179).
2. Explain and demonstrate Department of Transportation labeling, placarding, and marking regulations. (49 CFR, Part 172).
3. Explain the importance of choosing a state-certified hazardous waste hauler.
4. Provide information on how to obtain a list of certified hazardous waste haulers.
5. Explain the importance of choosing an appropriate hazardous waste treatment, storage, or disposal facility which is fully permitted to manage the type of hazardous wastes it receives.
6. Provide information on how to ensure that the facility chosen is fully permitted to manage the type of waste which the generator anticipates sending to it.
7. Explain the purpose and use of the hazardous waste manifest.
8. Introduce the Uniform Hazardous Waste Manifest and the California Hazardous Waste Manifest and explain the difference between them.
9. Explain circumstances when hazardous waste manifests are not required.

Suggestions for Development and Presentation

The most effective way to teach proper packaging, labeling, placarding, and marking with a minimum of equipment is to demonstrate them. The instructor may wish to develop a game in this area to achieve constant student interest.

References and Resources

49 Code of Federal Regulations

Attached hard copies of overhead slides.

Equipment can be ordered from the sources identified in the textbook at page 63.

Schedule and Assignments

This lesson is designed for 5 hours of lecture. Experience indicates that the material covered in this lesson is extremely important to students, and potentially very confusing. Therefore, instructors should carefully prepare for this lesson and be sure students are understanding the material as it is presented.

On-site Management of Hazardous Waste

Intent and Purpose

In this four hour laboratory, you will practice proper storage and lab packing of hazardous wastes, outline a bi-annual report of waste generation.

Laboratory Objectives

Upon completion of this Laboratory Session, the student will be able to:

1. Prepare an inventory of hazardous wastes.
2. Properly lab-pack a variety of hazardous wastes.
3. Outline a bi-annual report for a hazardous waste generator.

Laboratory Exercise

You should have brought your packages of “hazardous waste” with you to the laboratory. If you have not done so, please notify your instructor.

Your instructor will divide you and your classmates into several small groups. Each group will analyze its “hazardous waste stream” which consists of the “hazardous waste packages” from the group’s members.

As a group, you will prepare the following:

Environmental Technology

1. An inventory of your hazardous wastes, including any information which your group deems important (like you did in Laboratory 2).
2. A plan for proper storage of these hazardous wastes.

Such plan must include: a listing of incompatible wastes, storage requirements, consideration of any necessary regulatory requirements, packaging and labeling, and safety.

You and your group will then properly lab-pack your hazardous wastes to the maximum extent possible. *Make sure that your instructor watches you do the lab-packing.*

Once your lab-packing is complete, you and your group will prepare an outline of a Hazardous Waste Generator Bi-annual Report based on the wastes you just lab-packed.

To complete this laboratory, you may use any reference materials you deem appropriate, including the materials from the last session.

Suggestions for Development and Presentation

Detailed suggestions regarding this laboratory period would not be of much use since every time this laboratory is conducted a different set of circumstances will arise.

The key to this lab is for students to become comfortable with some of the on-site hazardous waste management requirements and generator recordkeeping obligations.

Bi-annual report requirements are constantly changing, so check with your DHS regional office prior to the lab.

The lab-packing exercise may be as realistic as your time and equipment allow. If you have drums, adsorbent, etc. to use, then let the students perform an actual lab pack; however, be sure to watch them to make sure it is done properly. Conversely, if your school has little or no lab packing equipment, you can simply use a trash can or large box as a substitute. In this case, it is critically important for you to explain the shortcomings of the equipment and methods you are using. We certainly do not want our students packing their hazardous wastes in cardboard boxes and tossing them in dumpsters!

References and Resources

ASTM Chemical Compatibility Chart

U.S.EPA "Instructions on preparation of the Bi-annual Report"

Schedule and Assignments

This laboratory session should be completed within 4 hours.

Off-Site Management of Hazardous Wastes

Intent and Purpose

In this lesson, students are introduced to regulatory requirements and technologies designed to manage hazardous wastes. The first topic discussed is recycling, and the student learns which types of wastes are recyclable. Secondly, students are introduced to major hazardous waste treatment processes and the types of wastes which such processes are designed to manage. Finally, hazardous waste disposal and the “land ban” are discussed.

Lesson Objectives

Successful completion of this lesson will enable the student to:

1. **Understand** the terms “recycling” and “reuse” and the difference between them. (these concepts were introduced in Lesson 2)
2. **Know** which types of hazardous wastes are amenable to recycling.
3. **Understand** the terms “treatment” and “disposal.”
4. **Understand** the “land ban” and its affect on generators and the hazardous waste management industry.
5. **Appreciate** the comprehensiveness of the hazardous waste facility permitting process.
6. **Know** the circumstances under which a permit variance may be obtained.
7. **Know** what technologies are subject to “permit-by-rule.”

Lesson Outline

1. Explain the concepts of “reuse” and “recycling.”
2. Explain what types of wastes are amenable to recycling.
3. Explain regulatory incentives for generators to have their wastes recycled.
4. Define the terms “treatment” and “disposal” and give examples of each.
5. Explain the land ban regulations and their impact on hazardous waste generators and the hazardous waste industry.
6. Explain the circumstances by which a permit variance may be obtained.
7. Explain the circumstances by which a facility may operate pursuant to a “permit-by-rule.”

Suggestions for Development and Presentation

Emphasize that a generator’s liability for its hazardous waste is eternal; therefore, a generator should be aware of how its hazardous waste is managed once it is transported off-site.

References and Resources

Title 26 California Code of Regulations

California Health and Safety Code

Schedule and Assignments

This module consists of one 2 hour lecture.

The entire textbook should be covered prior to concluding this lesson.

Marking, Labeling, and Placarding

Intent and Purpose

In this four hour laboratory session, students will become familiarized with requirements regarding the transportation of hazardous waste. In particular, packaging, labeling, and marking regulations are introduced. The Hazardous Waste Manifest is covered in the next Laboratory Session.

Laboratory Objectives

Successful completion of this lesson will enable the student to:

1. ***Properly prepare*** hazardous wastes for shipment by following federal and state labeling, packaging, and marking regulations.
2. ***Choose*** a certified hazardous waste hauler.
3. ***Select*** an appropriate treatment, storage, or disposal facility to receive the hazardous waste.
4. ***Recognize*** when a hazardous waste manifest is required.

Laboratory Exercise

1. Have students properly mark and label their lab packs from Laboratory 3.
2. Have students determine the proper label and packaging requirements for each of the following wastes:
 1. toluene
 2. perchloroethene
 3. used motor oil
 4. potassium superoxide
 5. tetrachloroethane

6. thionyl chloride
7. motor oil
8. solution containing ferrous chloride
9. glacial acetic acid
10. rubber cement

3. Have students determine the proper placarding requirements for various combinations of the above wastes.

Suggestions for Development and Presentation

An ample supply of the relevant labels and placards makes this Laboratory Session much more realistic and informative.

References and Resources

Title 49 Code of Federal Regulations

Schedule and Assignments

Lesson 3 should be completed prior to this Laboratory Session, which should take 4 hours.

Liabilities

Intent and Purpose

In this final lesson, the various liabilities associated with hazardous waste generation are presented.

Lesson Objectives

Successful completion of this lesson will enable the student to:

1. *Understand* the difference between criminal, civil and administrative liabilities.
2. *Understand* that single actions may result in multiple liabilities to multiple regulatory agencies.
3. *Understand* the various types of enforcement devices employed by regulatory agencies.

Lesson Outline

1. Review the concept of “cradle-to-grave” liability for hazardous waste generation.
2. Explain possible criminal liability for hazardous waste generators, focusing on the element of intentional wrongdoing.

Environmental Technology

3. Explain possible civil liability for hazardous waste generators in the following areas: to regulatory agencies; to employees; and to other parties.
4. Explain possible administrative liabilities for hazardous waste generators focusing on the concept of “dollars per day of non-compliance.”
5. Explain how one action taken by a hazardous waste generator may violate several laws and result in multiple liabilities to multiple regulatory agencies.
6. Explain the basic procedures of a criminal prosecution.
7. Explain the basic procedure of a civil lawsuit.
8. Explain the basic procedure for administrative compliance focusing on the Notice of Violation (“NOV”) and the Administrative Order for the following agencies: local fire department; local health department; California EPA, Department of Toxic Substances Control; U.S. EPA; and OSHA.
9. Suggest practical tips on how to handle inspections by regulatory agencies.

Suggestions for Development and Presentation

Since enforcement priorities are constantly changing, the instructor should attempt to ascertain the “hot issues” of enforcement at the time this lesson is presented and convey this information to the student.

Schedule and Assignments

This lesson should be presented in a 3 hour lecture.

Since this is the final lesson of the module, there are no additional assignments.

The Uniform Hazardous Waste Manifest

Intent and Purpose

This 8 hour Laboratory Session is devoted exclusively to the proper preparation of the Uniform Hazardous Waste Manifest. A copy of such manifest is provided in the attachments, and it may be reproduced as often as required.

Instructions for completion of the manifest are contained in the textbook and will not be repeated here; however, the instructor should prepare some lists of hazardous wastes, including mixtures, from which the student can prepare the manifests.

Whenever possible, the instructor should provide an actual multi-copy manifest for student use instead of a single-paged reproduction. Such actual forms can be ordered pursuant to instructions in the textbook.

Laboratory Objectives

Upon successful completion of this Laboratory Session, the student will be able to properly prepare a basic Uniform Hazardous Waste Manifest.

Pre-Lab Outline

1. Explain the purpose of the manifest system.
2. Using a sample list of hazardous wastes, demonstrate proper preparation of the manifest. Use of an overhead projector and line-by-line explanation of the instructions are recommended.
3. Explain problems inherent in manifesting hazardous wastes inter-state and to/from transfer stations.
4. Explain when and why an Exception Report must be completed.
5. Have students complete the attached Exercise.
6. Review, with the students, the proper completion of the attached Exercise.

Laboratory Exercise

You're the Hazardous Waste Compliance Coordinator for California Chemical Company ("CCC"), 1835 Chapman Avenue., Fullerton, CA 92717. Tel. (714) 736-9177. EPA I.D. # CAD793486582, Cal. Tax I.D. HQHA 18763211. CCC is owned and operated by U.S. Chem. Co. ("USCC") which is headquartered at another USCC subsidiary named Nevada Chemical Company ("NCC") at 314 W. Main St., Las Vegas, Nevada 97173. Tel. (622) 563-9177. Since you are also Hazardous Waste Compliance Coordinator for NCC, you spend most of your time traveling, by car, between Fullerton and Las Vegas. Your car phone no. is 9-8713444.

Today, you wish to send the following hazardous wastes to Chemical Waste Management at Kettleman Hills, CA from NCC. Nevada uses EPA's Uniform Hazardous Waste Manifest. Your transporter is ABC Transportation Company ("ABC"), EPA I.D. # NEV826719911. ABC is fully licensed to haul Hazardous Waste in Nevada, but in California it cannot transport DOT Class A or B Explosives. Thus, you instruct ABC to transfer any Class A or B Explosives to Terry's Trucking, EPA I.D. # CAD127459118, at the CA/NV border.

Instructions:

1. Complete the proper manifest(s) for the following hazardous wastes.
2. Prepare a short statement indicating how you will ensure your hazardous waste is properly placarded throughout the shipment.

<i>Hazardous Waste</i>	<i>Quantity</i>
Used Motor Oil	3 x 55 gallon drums
Used Motor Oil containing .035% (by volume) freon	1 x 5 gallon drum
Asbestos insulation 5% asbestos by weight	800 pounds/properly packaged
2, 3, 4, 6 tetranitrophenol	1 x 10 gallon drum

Environmental Technology

Thiophosgene	1 x 10 gallon drum
Detonating fuses	1 metal box with 100 fuses
Delay electric igniter	1 properly packaged
Cupric nitrate	65 pounds properly packaged
Solvent mixture 10% acetone, 60% toluene, 30% PCE	1 x 55 gallon drum
Concentrated HCL solution containing 150 ppb chromium 6+	1 x 100 gallon containers properly packaged

Suggestions for Development and Presentation

This laboratory session may be completed in one day; however, students prefer that this laboratory be completed in 2 sessions. As such, the instructor may cover items 1-5 above during the first session, assign the Exercise for homework, and then review the Exercise during the second session.

Industry surveys indicate that preparation of the manifest is the most common task assigned to hazardous waste technicians; therefore, a substantial amount of time is devoted to teaching proper manifesting procedures.

References and Resources

Instructions for completing the Uniform Hazardous Waste Manifest.

Schedule and Assignments

Lesson 4 should be completed prior to this Laboratory Session, which should take approximately 8 hours.

RCRA and Superfund

Instructor's Guide

Prepared By:

Stephen R. Onstot, Esq.
Burke, Williams, & Sorensen
611 West Sixth Street, Suite 2500
Los Angeles, CA 90017
(213) 236-0600

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Preface

This is the instructor's guide for a module entitled ***RCRA and Superfund***.

This module is part of ***Hazardous Waste Management Applications***, a 4 unit lecture/laboratory core course in the EHMT Associate Degree and Certificate Program. The course is designed to provide students with hands-on instruction in the *applications* of major laws and regulations dealing with hazardous waste management.

The course has been divided into three modules:

- **Module I Hazardous Waste Generator Compliance**
- **Module II RCRA and Superfund**
- **Module III Sampling and Analysis**

This modularization has been designed in such a way that the course can be taught as three separate "mini-courses." Modules I and III are each 45 hours and therefore represent 1.5 lecture/lab units. Module II is 18 hours so can be taught as a 1 unit course.

Modularization will allow the maximum flexibility for individual colleges to meet both traditional educational goals **and** the immediate needs of local industry. This flexibility is evidenced by the following available options, since the modules can be used in whole or part for:

- **Contract Education**
- **Community Service Classes**
- **Degree and Certificate Applicability**

The lab exercises have also been designed with this flexibility in mind. Each lesson plan states the recommended hours of lecture or laboratory time. Lab exercises can be taught either in separate lab periods **or** can be alternated with lecture topics in an integrated course approach.

RCRA and Superfund

Module Description

This module is comprised of 18 lecture hours covering the following aspects of RCRA and Superfund:

- Regulation of Treatment, Storage, and Disposal Facilities
- Treatment, Storage, and Disposal Technologies
- Overview of CERCLA Requirements and Liability
- Site Mitigation Process
- Asbestos and Other Real Estate Issues
- Air and Water Quality

Specific objectives are listed for each of the 6 lessons described in this module.

Texts

Suggested Student Texts:

There is no textbook required for this module; however, *RCRA Handbook*, 3rd ed., October, 1990 and *Superfund Handbook*, September, 1989 published by ENSR Consulting Engineering Co., Action MA are recommended references.

Other Instructor Resources and References are described within this document.

Instructor Note

Note to Instructors: It is suggested that the instructor using this module read through **all** lessons and labs prior to starting the course. In this way, later concepts which are built on earlier activities can be better anticipated and planned for.

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Regulation of Treatment, Storage, and Disposal Facilities

Intent and Purpose

In this lesson, an overview of the regulation of hazardous waste treatment, storage, and disposal facilities is presented. Beginning with the federal Resource Conservation and Recovery Act (“RCRA”), the “cradle-to-grave” method of hazardous waste regulation is presented, focusing on permitting/operating requirements for hazardous waste management facilities. State and local regulation in this area, especially with regards to land use, may also be presented as appropriate.

Lesson Objectives

Successful completion of this lesson will enable the student to:

1. *Understand* hazardous waste management priorities.
2. *Know* the major components of a RCRA Part B permit.
3. *Understand* the concept of “financial assurance” as it applies to facility operators.
4. *Understand* the “NIMBY” syndrome and associated issues involved with the siting of facilities.
5. *Understand* the concept of “land ban.”
6. *Understand* the role of state and local governments in the permitting process (i.e. preemption issues).

Lesson Outline

1. Explain the hazardous waste management priority system: reduce; reuse and recycle on-site; reuse and recycle off-site; treatment on-site; treatment off-site; and disposal.
2. Explain the RCRA permitting system, emphasizing the components of Part B of a RCRA permit.
3. Explain what is meant by the term “interim status.”
4. Describe how financial assurance requirements minimize financial risk to the public.
5. Explain the local (land use) permitting process and lead a discussion on the Not-In-My-Backyard (“NIMBY”) syndrome.
6. Explain the “land ban” regulations and lead a discussion on its positive and negative ramifications.
7. Explain any state or local permitting procedures. (For example, in California, permit-by-rule, variances, recycling requirements and county hazardous waste management plans should be discussed.)
8. Explain how local, state, and federal regulations may overlap, and which areas are pre-empted by federal or state regulation.

Suggestions for Development and Presentation

Siting of hazardous waste facilities and defining the various roles of federal, state, and local governments in their operation are excellent discussion topics, and they usually generate a variety of perspectives on hazardous waste management in general.

References and Resources

RCRA Handbook, chapters 4, 5, 6, and 11.

Schedule and Assignments

This lesson is designed to take 2 hours of classroom instruction.

Lesson 2 is devoted to student presentations on treatment, storage, and disposal technologies. Such lesson may be presented any time during the Module depending on how the instructor wishes to structure the course, the size of the class, and the amount of time the instructor wishes to give students to prepare their reports.

Treatment, Storage and Disposal Technologies

Intent and Purposes

In this lesson, students present oral reports on a treatment, storage, or disposal technology of their choice.

Lesson Objectives

Successful completion of this lesson will enable the student to:

1. ***Have an awareness*** of the various treatment, storage, and disposal technologies currently being researched or implemented.
2. ***Perform*** basic research in technical and regulatory areas.
3. ***Present*** a short written report on a technical subject.
4. ***Present*** a short oral report on a technical subject.
5. ***Respond*** to questions regarding his/her research.
6. ***Understand*** the importance of having good written and verbal communication skills.
7. ***Develop*** better listening skills.

Lesson Outline

Each student must prepare a written report and present an oral report on a hazardous waste treatment, storage, or disposal technology of his/her choice, although the instructor should attempt to avoid duplication of subjects.

Environmental Technology

1. **Written Reports:** Each written report must be typewritten (double spaced) and contain between two and three pages of text. In addition, each report shall contain a one-page schematic diagram illustrating the technology discussed. The text of the report shall address the following: what types of hazardous wastes are amenable to this type of treatment or disposal, a *brief* description of the treatment or disposal technology, whether such technology is experimental or approved by regulatory agencies, limitations of the technology, economic viability of the technology, and references.

Obviously, addressing the above items in two or three pages requires concise writing and avoiding excessive detail. *Two copies* of this report are due on the day of the oral report. One copy will be graded and returned to the student; the other copy will be reproduced and distributed to everyone in the class.

Grading of written reports— 60% of the grade is based on whether the student adequately addressed all of the required items in the text of the report, 20% of the grade is based on the illustrative value of the diagram, and 20% of the grade is based on the clarity and style of writing. In addition, points will be subtracted if the report is over or under the page limit, not typed or not typed double spaced, submitted late, or if two copies are not submitted.

2. **Oral Reports:** Students will present their oral reports to the entire class on a date given by the instructor. Each oral report shall be between 3 and 5 minutes long and cover the same items as the written report, including a schematic representation of the technology which must be presented as a visual aid. This may be accomplished by a demonstration, overhead slide, chart, or blackboard drawing. After the report, each student shall respond to questions from the class.

Grading of oral reports— Oral reports shall be graded as follows: 40% of the grade is based on coverage of the required items; 30% of the grade is based on quality and use of visual aids; 20% of the grade is based on quality of speaking skills (i.e. excessive use of notes, clarity of presentation, over or under time limit); 10% of the grade is based on the ability to respond to questions.

Students should note that the material presented in the oral and written reports is “testable.”

Suggestions for Development and Presentation

The anthology of written reports is a good reference for students to use in the future.

Do not forget that one objective of this lesson is to create an awareness of various technologies, not to involve the student in exhaustive research of technical issues. As such, the reports should be very general.

Attempt to abide by the suggested lengths of the oral and written reports. Such constraints require the student to present the material in a clear and concise manner.

References and Resources

There are no specific resources and references for this lesson; however, regulatory agencies, trade shows, environmental consulting firms, and equipment vendors are excellent resources for the student to employ in preparation of his/her reports.

Schedule and Assignments

It is suggested that instructors schedule 4 oral reports per hour. This allows sufficient time for questions and answers as well as any comments the instructor would like to make following each presentation.

Overview of CERCLA Requirements and Liability

Intent and Purpose

This lesson is an introduction to the laws which are triggered when a spill of a hazardous substance or other contaminant occurs. CERCLA is the primary statute used as a vehicle to teach the purpose and application of federal and state “superfunds” and the far-reaching liabilities for those who are somehow connected to a release of a hazardous substance. Brief consideration is given to theories of liability which supplement those provided by CERCLA.

Lesson Objectives

Successful completion of this module will enable the student to:

1. *Understand* the need for legislation to clean up past releases of hazardous substances.
2. *Understand* why “hazardous substances” excludes petroleum substances and asbestos.
3. *Understand* the concept of “superfund.”
4. *Understand* the major components of CERCLA, as amended by SARA.
5. *Appreciate* the large scope of liability for releases of hazardous substances.
6. *Recognize* that a state superfund exists.
7. *Understand* who can enforce the provisions of CERCLA, and to what extent.
8. *Understand* theories of liability which supplement CERCLA.

Lesson Outline

1. Explain that this lesson addresses what happens when a toxic spill occurs. Be sure to cover applicable release reporting requirements.
2. Explain the need for legislation to facilitate the cleanup of hazardous substance spills.
3. Explain the major components of CERCLA, including the definitions of “hazardous substances,” “facility,” “owner/operator,” and “release.”
4. Explain the concept of “superfund.”
5. Explain the concept of “strict liability,” “joint and several liability,” and “response costs.”
6. Explain how EPA may use the Superfund.
7. Explain how EPA may recover response costs from responsible parties.
8. Explain how private land owners may sue former landowners for recovery of response costs.

Environmental Technology

9. Explain the citizen suit provisions of CERCLA.

10. Explain other theories of environmental liability such as the Clean Water Act, public and private nuisance, negligence, state superfund, and trespass.

11. Explain how collateral parties such as lenders, environmental consultants, and real estate agents may be found liable for hazardous substance releases.

Suggestions for Development and Presentation

In discussing liability, “war stories” are often the best way to convey how extensive liability for toxic releases can become.

Many instructors may be somewhat uneasy in discussing liability if they are not attorneys. If this is the case, an environmental attorney should be scheduled as a guest lecturer to present this material.

References and Resources

42 CFR, Section 9601 et seq. (CERCLA)

California Health and Safety Code, Section 25300 et seq.

The Law of Hazardous Waste, Susan M. Cooke (published by Mathew Bender Co.)

Schedule and Assignments

This lesson is intended to be presented in 4 hours of lecture.

Site Mitigation Process

Intent and Purpose

This lesson introduces the student to the site mitigation process required by regulatory agencies in remediating contaminated sites. Key concepts presented in this lesson include the use and purpose of the California Bond Expenditure Plan, the National Contingency Plan, consent orders between potentially responsible parties and regulatory agencies, the new fee structure imposed by DHS, preliminary assessments, preliminary endangerment assessments, remedial investigations, feasibility studies, remedial action plans, risk assessments, and monitoring activities.

Lesson Outline

Successful completion of this lesson will enable the student to:

1. **Understand** the purpose and use of the Bond Expenditure Plan and the National Contingency Plan.
2. **Identify** the various options available to regulatory agencies to remediate contaminated sites.

3. *Understand* the purpose and content of a preliminary investigation.
4. *Understand* the purpose and content of a preliminary endangerment assessment.
5. *Understand* the purpose and content of a remedial investigation.
6. *Understand* the purpose of a Feasibility Study.
7. *Understand* the purpose and components of a Remedial Action Plan.
8. *Appreciate* the policy issues and interests involved in selecting and implementing cleanup strategies.
9. *Understand* the role of the public in the site mitigation process.
10. *Appreciate* the complexity of risk analysis.
11. *Know* the three major steps in performing a risk assessment.
12. Appreciate the many variables involved in establishing cleanup levels.

Lesson Outline

1. Review the basic purposes of CERCLA.
2. Explain the use of regulations to implement statutes.
3. Relate the National Contingency Plan to CERCLA.
4. Explain the purpose of the Bond Expenditure Plan.
5. Explain how sites are listed and prioritized in the Bond Expenditure Plan. Excessive detail is not necessary, but students should be aware that there is a systematic method used by the State to list and prioritize sites for cleanup.
6. Explain the various methods available to the State to ensure cleanup of contaminated sites. Include a discussion of identification of potentially responsible parties, consent orders, cleanup orders, lawsuits enforcing cleanup orders, use of the Superfund, public cost recovery lawsuits, private cost recovery lawsuits, liens and deed restrictions, and criminal prosecutions. Again, excessive detail is not necessary, but students should know that federal, state, and local governments and other interested parties have an extensive arsenal of weapons to ensure cleanup of contaminated sites.
7. Briefly explain California's new "fee for services" program imposed as part of regulatory oversight of cleanups.
8. Explain the content and purpose of a Preliminary Assessment. Be sure to emphasize the flexible nature of the PA to account for the unique circumstances present at each site.
9. Explain the content and purpose of the Preliminary Endangerment Assessment.
10. Lead a discussion on the advantages and disadvantages of "self-certified" site cleanups as compared to site cleanups having extensive regulatory oversight.

Environmental Technology

11.Explain the purpose and content of a Remedial Investigation. Lead a discussion of some of the policy issues involving an RI. For example, how comprehensive should the RI be, and to what extent are potentially responsible parties willing to spend money looking for liability?

12.Explain what a Feasibility Study is, why it is important, and how it is derived from data in the RI.

13.Lead a discussion as to the variety of interests which affect the final choice of remediation measures.

14.Explain the difficulty in establishing cleanup levels, and why such levels are standardized for drinking water but not soil.

15.Explain the general purpose of a risk assessment and how risk assessments are employed in determining cleanup levels. This explanation should be qualitative.

16.Explain post-cleanup requirements, including groundwater monitoring and restrictions on property use.

Suggestions for Development and Presentation

Since it is important for students to understand the logical progression of steps in the site cleanup process, instructors may choose to present this process in a time-line fashion.

References and Resources

“National Contingency Plan”

“Bond Expenditure Plan” (available from DHS)

Health and Safety Code 25347.6 (regulatory fees)

Health and Safety Code 25300 et seq. (site cleanup)

Guidelines for Preparing a Preliminary Endangerment Assessment, DHS, 1990.

Schedule and Assignments

This lesson is intended to take 3 hours to present.

Asbestos and Other Real Estate Issues

Intent and Purpose

This lesson presents and discusses environmental issues regarding real estate transactions. The focus is on issues regarding liability of several professions involved with real estate transactions.

Lesson Objectives

Successful completion of this lesson will enable the student to:

1. *Understand* the liabilities of owners of contaminated property.
2. *Understand* the liabilities of sellers of contaminated property.
3. *Understand* the liabilities of buyers of contaminated property.
4. *Understand* the liabilities of lessors and lessees of contaminated property.
5. *Understand* the liabilities of real estate brokers and agents in transactions involving contaminated property.
6. *Understand* the liability of environmental consultants.
7. *Understand* the liability of corporate officers, directors and shareholders.
8. *Understand* the liabilities of lenders which have a security interest in contaminated property.
9. *Understand* special laws regarding buying and selling property containing asbestos.

Lesson Outline

1. The outline of the lecture should parallel the objectives set forth above.
2. Excessive detail as to technical legal issues need not be discussed. Presentation of the lesson material should take about two hours and create an awareness level of knowledge in the students.
3. The final hour of lecture should be devoted to presenting and analyzing the Comprehensive Case Study attached hereto. Such case study should be reproduced and distributed to students immediately after the two hour lecture.

Suggestions for Development and Presentation

A complete set of overhead projector slides (hard copies) are provided in the attachments.

References and Resources

Materials attached.

Schedule and Assignments

This lesson consists of three hours of lecture/problem solving.

Air and Water Quality

Intent and Purpose

In this lesson, students will become familiar with the regulatory framework of air pollution and water pollution control. Since the regulatory requirements in these areas vary significantly by geographical region, this manual must necessarily approach air and water pollution from a broad perspective. Further, unlike the previous lessons in this module, this lesson does not present the requirements of RCRA or Superfund law; rather, it provides an opportunity for the instructor to demonstrate how RCRA and Superfund requirements inter-relate with air and water quality laws, specifically the Clean Air Act and the Clean Water Act.

Lesson Objectives

Successful completion of this lesson will enable the student to:

1. *Understand* the agencies responsible for air pollution control.
2. *Understand* and distinguish between the concepts of “stationary air pollution sources” and “mobile air pollution sources.”
3. *Understand* the concept of “ambient air quality standards.”
4. *Understand* the term “toxic air contaminants.”
5. *Understand* the purpose and reasons for Air Pollution Control Districts.
6. *Know* when an APCD permit is required.
7. *Know* when an APCD variance is available.
8. *Understand* the process for enforcing air pollution regulations.
9. *Understand* the regulation of motor vehicles and other mobile sources of air pollution.
10. *Understand* the regulatory framework for control of water pollution.
11. *Understand* the purpose of the Regional Water Quality Control Boards and their relationship to the State Water Resources Control Board.
12. *Know* the major requirements of the Porter-Cologne Water Quality Act and Clean Water Act.
13. *Know* what an NPDES permit is, and when one is required.
14. *Understand* the process of enforcing water pollution regulations.

Lesson Outline

1. Briefly explain how RCRA, CERCLA, the Clean Air Act, and the Clean Water Act are inter-related.

Environmental Technology

2. Explain the federal Clean Air Act, how such Act is implemented by EPA, and its impact on California.
3. Explain what the California Air Resources Board is, and its responsibilities under state and federal law.
4. Explain and differentiate between Air Pollution Control Districts and Air Quality Management Districts.
5. Explain why enforcement of air pollution control laws is most effectively performed at the local level through APCDs or AQMDs.
6. Explain and differentiate between stationary and mobile sources of air pollution.
7. Explain the concepts of National Ambient Air Quality Standards and State Implementation Plans.
8. Explain and define a “toxic air contaminant.”
9. Explain how toxic air contaminants are regulated.
10. Explain, generally, the “bubble system.”
11. Explain, generally, the air emissions permit process.
12. Explain, generally, the concept of permit variances and when they are available.
13. Explain the enforcement process for air pollution control violations.
14. Explain, generally, how vehicle emissions are regulated.
15. Introduce the federal Clean Water Act and provide an overview of its purpose and major provisions.
16. Explain EPA’s role in implementing the Clean Water Act.
17. Introduce the Porter-Cologne Water Quality Act and lead a discussion as to its purpose and major provisions.
18. Explain the inter-relationship between the Clean Water Act and the Porter-Cologne Water Quality Act.
19. Introduce, and explain the purpose of, the State Water Quality Control Board and the Regional Water Quality Control Boards.
20. Lead a discussion as to whether water quality is best regulated at the local/regional level.
21. Explain what an NPDES permit is, and when it is needed.
22. Explain the process for enforcing water pollution control laws.

Suggestions for Development and Presentation

Present the inter-relationships between regulatory agencies graphically.

Sampling and Analysis

Instructor's Guide

Prepared By:

Stephen R. Onstot, Esq.
Burke, Williams, & Sorensen
611 West Sixth Street, Suite 2500
Los Angeles, CA 90017
(213) 236-0600

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Preface

This is the instructor's guide for a module entitled *Sampling and Analysis*.

This module is part of *Hazardous Waste Management Applications*, a 4 unit lecture/laboratory core course in the EHMT Associate Degree and Certificate Program. The course is designed to provide students with hands-on instruction in the *applications* of major laws and regulations dealing with hazardous waste management.

The course has been divided into three modules:

- **Module I Hazardous Waste Generator Compliance**
- **Module II RCRA and Superfund**
- **Module III Sampling and Analysis**

This modularization has been designed in such a way that the course can be taught as three separate "mini-courses." Modules I and III are each 45 hours and therefore represent 1.5 lecture/lab units. Module II is 18 hours so can be taught as a 1 unit course.

Modularization will allow the maximum flexibility for individual colleges to meet both traditional educational goals **and** the immediate needs of local industry. This flexibility is evidenced by the following available options, since the modules can be used in whole or part for:

- **Contract Education**
- **Community Service Classes**
- **Degree and Certificate Applicability**

The lab exercises have also been designed with this flexibility in mind. Each lesson plan states the recommended hours of lecture or laboratory time. Lab exercises can be taught either in separate lab periods **or** can be alternated with lecture topics in an integrated course approach.

Sampling and Analysis

Module Description

This module is comprised of 45 lecture/laboratory hours covering the following aspects of sampling and analysis:

- Overview of Basic Chemistry, Statistics, and Metric System
- Assessment of Risks
- Evaluating Environmental Reports
- How to Properly Sample Wastes
- Site Investigation Requirements
- Determining Sampling Locations
- Preparing Chain-of-Custody Forms
- Preparation of Samples
- Use of Laboratory and Field Equipment and Instruments
- Recordkeeping and Reporting Requirements

Specific objectives are listed for each of the 7 lessons and 7 laboratory exercises described in this module.

Texts

Suggested Student Texts:

Materials to make up a student syllabus are included in this packet. These handouts can be found as supplements after the lessons or labs they refer to.

Instructor Resources and References are described within this document.

Note to Instructors: It is suggested that the instructor using this module read through **all** lessons and labs prior to starting the course. In this way, later concepts which are built on earlier activities can be better anticipated and planned for.

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Overview of Basic Chemistry, Statistics and the Metric System

Intent and Purpose

In this lesson, basic chemistry concepts, statistics, and the metric system are reviewed to the extent that they are relevant to subsequent lessons and laboratory exercises.

Lesson Objectives

Successful completion of this lesson will enable the student to:

1. *Understand* the concepts of acids and bases, pH, nomenclature of common aliphatic and aromatic compounds, and the difference between ionic and covalent bonding.
2. *Understand* the importance of statistical analysis in the investigation and reporting of chemical contamination.
3. *Understand* the concepts of mean, median, standard deviation, level of confidence, error, and propagation of error.
4. *Understand* the metric units for mass, volume, and length.
5. *Know* the metric sub-units of kilo, deci, centi, milli, and micro.
6. *Understand* the concepts of parts-per-million and parts-per-billion.

Lesson Outline

1. Take an informal poll of the class to determine how many students have met the prerequisites of the Module.
2. Review the conceptual distinction between acids and bases.
3. Introduce the concept of pH and explain its importance in the hazmat field.
4. Explain the concept of organic chemistry.
5. Explain the difference between aliphatic and aromatic compounds. Give examples of each.
6. Explain the basic rules of nomenclature for aliphatic and aromatic compounds.
7. Explain what “BTEX” means. (Benzene, Toluene, Ethyl-benzene, and Total Xylenes)
8. Identify the major EPA test methods employed to detect/quantify common constituents of contamination. At a minimum, students should be familiar with 418.1, 8015, 8020, 8240, 8080, and CAM metals.
9. Explain the concepts of mean, median, standard deviation, and levels of confidence and their significance in the environmental field.

10. Explain the concept of error and the effects of propagation of error.

11. Review the metric system.

12. Explain the terms “parts-per-million” and “parts-per-billion.”

Suggestions for Development and Presentation

Demonstrate the use of a pH meter in explaining the concept of pH.

Provide “real life” examples of ppm and ppb to help students understand such concepts.

References and Resources

Information as to the concepts presented in this lesson may be found in nearly all basic chemistry and statistics textbooks.

Schedule and Assignments

This lesson is designed for 2 hours of lecture and should be completed prior to Laboratory 1 of this Module.

Students should read the attached “SAMPLING AND ANALYSIS UNIT—WEEK ONE MODULE” prior to Lesson 2.

Statistics and the Metric System

Intent and Purpose

In this laboratory, students will practice their skills in performing basic calculations using the metric system and applying basic principles of statistics.

Laboratory Objectives

Successful completion of this laboratory will enable the student to:

1. *Perform* basic calculations using algebra and the metric system.
2. *Perform* basic statistical analyses.

Laboratory Outline

1. Have students complete the attached worksheet.

Suggestions for Development and Presentation

This laboratory should be completed after Lesson 1 of this Module; otherwise, a pre-lab may be necessary to refresh the student's recollection of basic statistics and the metric system.

References and Resources

Standard textbooks in chemistry and statistics.

Schedule and Assignments

This laboratory is designed to be completed in 3 hours.

The student should read "Experiment One—Sample Characterization and WET Extraction " prior to the next laboratory session.

Sampling and Analysis I

Intent and Purpose

In this lesson, many items that are to be considered in a sampling plan are presented. Using the sampling plan as the framework, representative sampling, sample types, and methods for selecting sampling locations are presented.

Sample characterization, based on observation and simple field tests, is presented to prepare the student for the laboratory exercise.

Lesson Objectives

Successful completion of this lesson will enable the student to:

1. **List** and describe the major steps involved in a CERCLA/SARA hazardous site investigation plan.
2. **List** and describe the major factors that must be taken into consideration when preparing a sampling plan.
3. **Describe** the differences between an environmental and hazardous sample.
4. **List and define** four basic types of sampling techniques.
5. **Describe** three commonly used methods of determining sampling locations.
6. **Describe** eight sample characteristics.
7. **Demonstrate** how to determine the density of a liquid.
8. **Describe** the purpose of lab standards, and their use in instrument calibration.
9. **Demonstrate** how to calibrate and use a field pH meter.
10. **List** the steps involved in the WET procedure.

Lesson Outline

1. Explain the major steps involved in a CERCLA/SARA cleanup.
2. Define and explain the purpose of a sampling plan.
3. Define and explain the significance of environmental or background samples and distinguish them from hazardous samples.
4. Explain various types of sampling techniques.
5. Explain three methods generally used to select sampling locations.
6. List and explain the importance of sample characteristics.
7. Explain the concept of density and perform a sample calculation to determine the density of a liquid.
8. Define “lab standards” and explain their importance in instrument calibration.
9. Demonstrate how to calibrate and use a field pH meter.
10. Explain the WET procedure and what it is used for.

Suggestions for Development and Presentation

Draw a map of a hypothetically contaminated site and give students 10-15 minutes to prepare their own “sampling plan.” Then, select two or three students to present their sampling plan to the class and justify the sampling locations. This exercise is very effective for teaching the concept of “judgment sampling,” for each student’s sampling plan is likely to be unique and based on different “judgments.”

References and Resources

1. SAMPLING AND ANALYSIS —WEEK ONE MODULE

Schedule and Assignments

This lesson is designed for three hours of lecture/discussion.

Students should read the attached “SAMPLING AND ANALYSIS UNIT—WEEK TWO MODULE” prior to Lesson 3.

Sampling and Analysis I

Intent and Purpose

This laboratory exercise is intended to familiarize the student with GLP, the power of observation, careful recordkeeping, liquid-liquid separation, density/specific gravity determination, pH measurement, instrument calibration, and the California WET procedure.

Laboratory Objectives

Successful completion of this laboratory will enable the student to:

1. *Understand* the importance of careful observation.
2. *Perform* a liquid-liquid separation.
3. *Calculate* densities and specific gravities.
4. *Calibrate* and use a pH meter and conductivity meter.
5. *Perform* a modified California WET test.

Laboratory Outline

See Experiment One

Suggestions for Development and Presentations

LABORATORY EQUIPMENT AND SUPPLIES:

The following equipment is required to perform this experiment.

Each lab station:

- Beakers, 150 mL (2)
- Separatory funnel, 100 mL
- Graduated cylinder, 10 mL
- Mortar & pestle
- Burner or hot plate
- Iron ring
- Ring stand
- Wire gauze
- Glass stirring rod, 15 cm
- Thermometer, 110°C
- Funnel
- Volumetric flask, 100 mL
- Wash bottle, DI water

Environmental Technology

Common Equipment & Supplies Available:

- Vial or pack of pH test paper (Range 2 - 12)
- pH meter and buffer solutions
- Electrical conductivity meter
- Lab tissue
- Balance, 0.01 g or better
- Box of filter paper, 11 cm, Whatman # 1

REAGENTS REQUIRED:

Each lab station needs only one set of samples. The samples prepared for this experiment will be the same ones used in each of the other experiments.

It is recommended that 40 mL VOA sample bottles be used for all samples.

Sample #1: 30 mL of apple vinegar/water solution

Prepare by solution by diluting 100 mL of vinegar to 1000 mL with DI water. (Distilled white vinegar may be used, but apple vinegar preferred due to color.)

(0.1 M $\text{HC}_2\text{H}_3\text{O}_2$ may also be used as a substitute.)
(Produces a solution with pH = 3 - 4.)

Sample #2: 15 mL of hexane and 15 mL of DI water

Any immiscible alkane could be substituted for the hexane layer.

Sample #3: 30 g of a mixture composed of $\text{CuSO}_4 \cdot 5 \text{H}_2\text{O}$, $\text{MgSO}_4 \cdot 7 \text{H}_2\text{O}$ & $\text{Na}_2\text{SO}_4 \cdot 10 \text{H}_2\text{O}$

The mixture should be prepared using equal numbers of grams of each hydrate. It is suggested that some larger sized crystals of the cupric sulfate pentahydrate be included in the sample.

$\text{CuSO}_4 \cdot 5 \text{H}_2\text{O}$ = 36.1%, $\text{MgSO}_4 \cdot 7 \text{H}_2\text{O}$ - 51.2%, & $\text{Na}_2\text{SO}_4 \cdot 10 \text{H}_2\text{O}$ - 55.9%, therefore, if the mixture were homogeneous, student results would theoretically give an answer of 47.7% water.

Sample #4: 30 mL of Chloraseptic/water solution

Chloraseptic throat spray may be purchased at any drug store. (It reports 1.4% total phenol, as its active ingredients.) Dilute 10 mL of Chloraseptic to 100 mL with DI water.

As a substitute, a 0.015 M phenol water solution could be used. (Chloraseptic is preferred due to its color and household familiarity.)

Sample #5: 9 g of a sand & $\text{K}_2\text{Cr}_2\text{O}_7$ mixture

CAUTION: The sand must be free from any organic materials. This mixture is going to be a ground into a powder. $\text{K}_2\text{Cr}_2\text{O}_7$ is a strong oxidizer!

Weigh out and mix 9.00 g of (20 - 30 mesh) sand and 0.0100 g of potassium dichromate. (When later extracted and diluted to 100 mL with DI water, using the modified WET procedure, should produce a solution containing 0.336 mg Cr (VI)/L.

References and Resources

See Lesson 2

The student's guide for this experiment is attached to Laboratory 1 and should be read prior to this laboratory session.

This laboratory is designed to take three hours.

Students should read the attached "EXPERIMENT TWO" prior to the next laboratory session.

Sampling and Analysis II

Intent and Purpose

In this lesson, the sampling plan theme is continued. The topics introduced are sample collection and preservation, types of multiple samples, and sample labeling, custody and transportation. The environmental sampling compartments are also introduced. The focus in this lesson will be on soil and solid waste sampling equipment.

Lesson Objectives

Successful completion of this module will enable the student to:

1. **List and describe** four different types of multiple samples.
2. **Demonstrate** the proper completion of a sample label.
3. **List** the information that must be entered in the field logbook.
4. **Demonstrate** a knowledge of the information to be recorded on a chain-of-custody form.
5. **Describe** the difference between shipping environmental and hazardous samples.
6. **Identify** the three environmental sampling compartments.
7. **Recognize and explain** the use of at least four common soil and solid waste sampling devices.
8. **Demonstrate** the ability to use a random numbers table to select random sampling sites.
9. **Describe** the preparation and purpose of a composite sample.
10. **Demonstrate** the ability to determine the percent of water in a mixture.
11. **Discuss** the difference between precision and accuracy of a measurement.

Lesson Outline

1. Continuing with the theme of a sampling plan being a “blueprint for action”, this lesson presents additional items that need to be specified by the plan.
2. The value of sampling plans is continued including:
 - Establishing a link with the certified laboratory that will be doing the analysis
 - Determining the collection containers, preservatives, if any, holding times and storage conditions acceptable
 - Use of multiple samples, including duplicate, split, spiked and blanks
 - Labeling practices for samples
 - Recording of field sampling logbook records
 - Establishing chain-of-custody considerations
3. The requirements for sample handling and shipping includes:
 - Shipping requirements for environmental & hazardous samples
 - Packing & shipping requirements (DOT) for hazardous samples
 - Shipping paper & carrier requirements for hazardous samples
4. The sampling of environmental compartments includes:
 - Use and care of soil and solid waste sampling equipment
5. The methodology used to obtain composite samples includes:
 - Random sampling techniques
 - Composite sample preparation

Suggestions for Development and Presentation

The importance of selecting the certified laboratory to perform the necessary analysis is introduced in this lesson due to the critical role it plays in determining sampling methodology. Additional considerations on laboratory selection will occur in a later lesson.

Since sampling is one of the possible future jobs for many of the technicians, considerable emphasis should be placed on the concerns for labeling, chain-of-custody considerations, and transportation of hazardous samples. Although, DOT shipping requirements will also be presented in another course in the program, this introduction can serve as a foundation for later study.

Practice filling out sample labels and forms could be a useful classroom exercise. Slides of properly packed and labeled containers would add interest to this topic.

Soil and solid waste sampling equipment should be demonstrated to the class, with particular attention being given to its use and care. The proper method of cleaning the equipment between samples should also be demonstrated.

With the exception of the random and composite sampling techniques used at the beginning of this experiment, this is a typical chemistry lab. At its conclusion, however, comparison of the student data should lead to a discussion of the terms “precision” and “accuracy”.

References and Resources

General Background

- Student Lesson Two
- Teachers Guide

Multiple Samples

- UC Davis Extension, Course: Field Monitoring & Sampling of Hazardous Materials Notebook, II. SAMPLING PLAN

Sample Labeling, Custody & Transporting

- UC Davis Extension, Course: Field Monitoring & Sampling of Hazardous Materials Notebook, II. SAMPLING PLAN, Part 5 & IV. QUALITY ASSURANCE/QUALITY CONTROL

Sampling Equipment

- UC Davis Extension, Course: Field Monitoring & Sampling of Hazardous Materials Notebook, VII. SOIL SAMPLING

Random & Composite Sampling Techniques

- UC Davis Extension, Course: Field Monitoring & Sampling of Hazardous Materials Notebook, II. SAMPLING PLAN

Schedule and Assignments

This lesson is designed for 3 hours of lecture.

Students should read the attached “SAMPLING AND ANALYSIS UNIT — WEEK THREE MODULE” prior to Lesson 4.

Sampling and Analysis II

Intent and Purpose

This experiment is intended to familiarize the student with the principles of sampling solid materials. The student will gain experience with representative, random, and composite sampling techniques. This experiment gives quantitative results and has been structured for a post-lab discussion on accuracy and precision of laboratory data.

Laboratory Objectives

Successful completion of this laboratory will enable the student to:

1. **Recognize** common techniques of sampling solid materials.
2. **Understand** the difference between representative, random, and composite sampling and their application.
3. **Understand** the difference between precision and accuracy.

Laboratory Outline

See Experiment Two

Suggestions for Development and Presentation

LABORATORY EQUIPMENT AND SUPPLIES:

The following equipment is required to perform this experiment.

Each Lab Station:

- Crucible tongs
- Crucible & cover (2)
- Burner
- Iron ring
- Ring stand
- Clay triangle
- Heat resistant pad
- Spatula, stainless steel

Common Equipment & Supplies Available:

- Trier or scoopula
- Analytical balance (or centigram balance, if not available)

REAGENTS REQUIRED:

Each lab station needs only Sample #3 from the set of samples.

Sample #3: 30 g of a mixture composed of $\text{CuSO}_4 \cdot 5 \text{H}_2\text{O}$, $\text{MgSO}_4 \cdot 7 \text{H}_2\text{O}$ & $\text{Na}_2\text{SO}_4 \cdot 10 \text{H}_2\text{O}$

The mixture should be prepared using equal numbers of grams of each hydrate. It is suggested that some larger sized crystals of the cupric sulfate penthydrate be included in the sample.

$\text{CuSO}_4 \cdot 5 \text{H}_2\text{O}$ - 36.1%, $\text{MgSO}_4 \cdot 7 \text{H}_2\text{O}$ - 51.2%, & $\text{Na}_2\text{SO}_4 \cdot 10 \text{H}_2\text{O}$ = 55.9%, therefore, if the mixture were homogeneous, student results would theoretically give an answer of 47.7% water.

References and Resources

See Lesson 3

Schedule and Assignments

The student's guide for this experiment is attached to Laboratory 2 and should be read prior to this laboratory session.

This laboratory is designed to take three hours.

Students should read the attached "EXPERIMENT THREE" prior to the next laboratory session.

Sampling and Analysis III

Intent and Purpose

In this lesson, the final topics that will be considered in a sampling plan are presented. Still using the sampling plan as the framework, both field and laboratory QA/QC controls that are needed to ensure the data quality objectives (DQOs) are presented.

The focus of this lesson is on ground and surface waters and hazardous liquids. Several different samplers are discussed for each type of sampling need.

Lesson Objectives

Successful completion of this lesson will enable the student to:

1. **List and describe** four different types of samples that can be used to assure the quality of field samples.
2. **List and describe** six different types of samples that can be used to assure the quality of analytical results.
3. **Describe** the necessity of well purging.
4. **List and describe** the operation of two different types of ground water sampling devices.
5. **List and describe** the operation of four different types of surface or liquid waste sampling devices.

6. *Describe* the operation and use of a spectrophotometer.
7. *Demonstrate* the ability to calculate the concentration of solutions resulting from dilutions.
8. *Demonstrate* the preparation and interpretation of a Beer's Law plot.
10. *Demonstrate* a treatment for a hexavalent chromium, hazardous waste solution.

Lesson Outline

At this point, students will have completed the two previous modules and will be comfortable with the material added in the lecture portion of this module.

The final topics to be presented in a sampling plan include:

- Quality control of field samples by the use of field duplicates, field blanks, trip blanks, and ambient blanks
- Quality control of analytical results by the use of calibration standards, control samples, reagent blanks, matrix spikes, surrogate spikes, and laboratory duplicates

The discussion of ground and surface water, or liquid hazardous waste sampling equipment includes:

- Bailers
- Bladder or gas-operated squeeze pumps
- Coliwasa
- Grab samplers
- Dippers
- Bomb samplers

Background information on the operation of a spectrophotometer includes:

- Transmittance of light through solutions
- Absorption spectra
- Standard solutions
- Solution dilutions
- GLP for cuvette & instrument operation
- Graph preparation & interpretation

The treatment process for hexavalent chromium solution provides a real-world example of a waste water treatment process.

Suggestions for Development and Presentation

At this point, students should find the pace and material becoming quite comfortable. This module brings to a close the use of the sampling plan as the “blueprint for action”. Emphasis on field and laboratory QA/QC should demonstrate to the student the amount of care and importance associated with a sampling and analysis procedure.

The introduction and uses of sampling equipment for the liquid compartments should provide an area of special interest due to its enormity.

Classroom demonstrations, and slides demonstrating technicians in actual sampling situations will do much to add interest to the presentation. Again, emphasis needs to be placed on sources of sample contamination. Due to the inexpensiveness of some frequently used liquid sampling devices, coupled with the difficulty of its complete decontamination, in this area disposable equipment may become an option.

References and Resources

General Background

- Student Lesson Three
- Teachers Guide

QA/QC Control Plans

- UC Davis Extension, Course: Field Monitoring & Sampling of Hazardous Materials Notebook, IV. QUALITY ASSURANCE/QUALITY CONTROL

Liquid Sampling Equipment

- UC Davis Extension, Course: Field Monitoring & Sampling of Hazardous Materials Notebook, VI. LIQUID AND CONTAINER SAMPLING (DRUMS, TANKS)
- UC Davis Extension, Course: Field Monitoring & Sampling of Hazardous Materials Notebook, VIII. GROUND AND SURFACE WATER SAMPLING

Chromium (VI) Determination by Spectrophotometry

- Hajjian, Harry G. Sr. and Pecsok, Robert L., *Modern Chemical Technology*, Volume I, Prentice hall, 1988. Chapter 7
- *HMTRI, Course HMT 260*, Pages 4:28-29
- U.S. EPA, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*; SW-846, Method 7196, Environmental Protection Agency, September 1986.

Schedule and Assignments

This module is designed for 3 hours of lecture.

Students should read the attached “SAMPLING AND ANALYSIS UNIT — WEEK 4 MODULE” prior to Lesson 5.

Sampling and Analysis III

Intent and Purpose

This experiment makes use of the solution prepared in Experiment One using the WET. Through the use of a “laboratory standard” solution and its dilutions, students are able to create a Beer’s Law plot. The concentration of Cr(VI) extracted from sample #5 can then be quantitatively calculated using a modified SW-846 spectrophotometric determination.

Laboratory Objectives

Successful completion of this laboratory will enable the student to:

1. *Understand* the concept of dilution and its application in creating a sample suitable for analysis.
2. *Understand* how dilution may increase error, thereby reducing precision and accuracy.
3. *Understand* the importance of laboratory standards.
4. *Create* a Beer’s Law plot.
5. *Perform* a simple spectrophotometric analysis.

Laboratory Outline

See Experiment Three

Suggestions for Development and Presentation

LABORATORY EQUIPMENT AND SUPPLIES

The following equipment is required to perform this experiment.

Each Lab Station:

- Beaker, 150 mL
- Beaker, 1000 mL
- Graduated cylinder, 10 mL
- Graduated cylinder, 100 mL

- Glass stirring rod, 15 cm
- Volumetric flasks, 100 mL (9)
- Cuvettes (2) or matched pair of test tubes
- Spectrophotometer
- Graduated pipette, 10 mL
- Rubber bulb
- Wash bottle, DI water
- Vial or pack of pH test paper (Range 2 - 12)
- Ruler or straight edge
- Test tube rack

Common Equipment & Supplies Available:

- Lab tissue

REAGENTS REQUIRED:

The following reagents will need to be present in sufficient quantities to supply each lab station:

“Laboratory Standard” $K_2Cr_2O_7$ Solution

Weight out 0.1414 g of dry $K_2Cr_2O_7$ and dissolve in enough water to make 1 liter of solution. This should result in a solution that is 4.81×10^4 M $K_2Cr_2O_7$ or 50.0 mg Cr(VI)/L.

This solution must now be further diluted. Pipette 10 ml of this solution into a 100 mL volumetric flask. Add sufficient water to make 100 mL of solution. This dilution results in the “laboratory standard” solution that is 4.81×10^5 M $K_2Cr_2O_7$ or 50.0 mg Cr(VI)/L.

This solution must now be additionally diluted. Pipette 10 ml of this solution into a 100 mL volumetric flask. Add sufficient water to make 100 mL of solution. This dilution results in the “laboratory standard” solution that is 4.81×10^5 M $K_2Cr_2O_7$ or 5.00 mg Cr(VI)/L.

Depending on the number of grams of potassium dichromate actually used, the students are to be told that the “laboratory standard” molar concentration.

Each lab station will need only 35 mL of this solution.

Diphenylcarbazide Solution

Dissolve 0.250 g 1,5-diphenylcarbazide ($C_6H_5NHNHCONHNHC_6H_5$) in 50 mL acetone. For ease of student use, place this solution in brown dropper bottles. (Solution should be discarded when it becomes discolored.)

Each lab station will need only 10mL of this solution.

10% Sulfuric Acid Solution

Dilute 100 mL of reagent grade concentrated sulfuric acid, H_2SO_4 , to 1 liter.

Environmental Technology

Each lab station will need only about 2 mL of this solution.

(Optional) 10% (wt/vol) Sodium Hydroxide Solution

Only a small amount of this solution will be required to adjust the pH after the reduction of the hexavalent chromium solution.

Either dissolve 100 g of sodium hydroxide pellets in sufficient water to produce 1 liter of solution, (CAUTION: Excessive heat is generated in this process - do only in pyrex container and with appropriate safety equipment.)

or, by diluting 42 mL of 6M NaOH to 100 mL of solution.

Sodium Bisulfate (solid)

The amount of NaHSO_3 required will be very small. The reaction ratio is 3 moles of NaHSO_3 permole of $\text{K}_2\text{Cr}_2\text{O}_7$. It would require, for example, only 0.15 g of NaHSO_3 to reduce all of the $\text{K}_2\text{Cr}_2\text{O}_7$ in the “lab standard” solution.

Sample #5: 9 g of a sand & $\text{K}_2\text{Cr}_2\text{O}_7$ mixture

CAUTION: The sand must be free from any organic materials. This mixture is going to be ground into a powder. $\text{K}_2\text{Cr}_2\text{O}_7$ is a strong oxidizer!

Weigh out and mix 9.00 g of (20 - 30 mesh) sand and 0.0100 g of potassium dichromate. (When later extracted and diluted to 100 mL with DI water, using the modified WET procedure, should produce a solution containing 0.336 mg Cr (VI)/L.

References and Resources

See Lesson 4

Schedule and Assignments

The student's guide for this experiment is attached to Laboratory 3 and should be read prior to this laboratory session.

This laboratory is designed to take three hours.

Students should read the attached “EXPERIMENT FOUR” prior to the next laboratory session.

Sampling and Analysis IV

Intent and Purpose

In this lesson, the last of the three environmental sampling compartments, air, will be discussed. It is intended that this discussion include the procedures and equipment used by both the industrial hygienist's as well as monitoring for air toxics.

In addition to the information that has already been included in previous modules, final considerations are given to the selection of a certified analytical laboratory.

Finally, a discussion about sampling can not be complete without some mention of sampler safety. It is true that many of the students have heard, or will be hearing, about wearing appropriate PPE when working with hazardous materials. What they may not realize is the toxic nature of some of the substances they may be asked to sample. A reminder should be included of some of the physical dangers that could be involved when sampling in confined spaces, or from leaking rail cars or “bloated” drums!

Lesson Objectives

Successful completion of this lesson will enable the student to:

1. **List and describe** the operation of five different types of air sampling equipment.
2. **List** two factors that should always be considered when selecting a certified analytical laboratory.
3. **Describe** what is meant by an SW-846 procedure.
4. **Describe** the difference between an “acute” and “chronic” exposure.
5. **Describe** the operational principles involved in gas chromatography.
6. **Demonstrate** the ability to operate a gas chromatograph.
7. **Explain** the appearance and significance of the peaks on a chromatogram.
8. **Explain** the changes that result on a chromatogram when a matrix spike is used.
9. **Explain** what the term “retention time” means with regard to gas chromatography.

Lesson Outline

This module brings the short Sampling & Analysis Unit to a close. It is intended to give the student a look at both the sampling and the analytical laboratory areas. These are both likely places of employment for the technician.

The final sampling compartment, air, and its associated industrial hygiene applications include:

- Discussion of the factors that make for good field air sampling equipment
- Consideration of large concentration gradients that can occur in air sampling
- The use of industrial hygiene sampling equipment like passive dosimeters, colorimetric indicator tubes and portable meters, like a combustible gas indicator
- A discussion of the similarities and differences between a PID and FID

The remaining considerations for the selection of a certified analytical laboratory include:

Environmental Technology

- The lab's reputation for providing quality results in a particular analysis area.
- A discussion of services provided, considered against cost and convenience.
- Considerations for "additional" or "hidden" costs, in the form of surcharges, for quick turn-around times.
- A brief discussion about SW-846 procedures and occasional variances granted by EPA.

Sampler safety takes into consideration physical as well as chemical exposures, such as:

- Acute exposures
- Chronic exposures
- Worker SOPs
- Medical surveillance programs

Chromatography as a separation technique includes:

- Types of chromatography in use and their similarities and differences;
- A discussion of the operation of a gas chromatograph;
- Preparation and injection procedures used on a gas chromatograph;
- An explanation of the significance of the peaks on a chromatogram;
- A discussion of the effects of a matrix spike on a chromatogram;

Suggestions for Development and Presentation

This lesson presents the last opportunity to explore the sampling and analysis areas. Significant numbers of technicians are and will be employed as samplers and in laboratory sample preparation. It is important for them to get a feeling of the care that must be exercised when given the responsibility of taking or analyzing samples.

Although, the technician may not be asked to select an analytical laboratory, it is important for them to be aware of some of the services they do provide, and their associated costs.

Through the use of classroom demonstrations with the air sampling equipment, much interest can be generated. Try having a student inflate a toy balloon, then use the combustible gas meter to measure the oxygen in the air inside the balloon! Open a bottle of household ammonia cleaning solution, and show the effects on a Dreager tube! Use a felt tip pen near an instrument that measures volatile organic compounds.

References and Resources

General Background

- Student Module Four
- Teachers Guide

Air Sampling Equipment

- UC Davis Extension, Course: “Field Monitoring & Sampling of Hazardous Materials” Notebook, IX. Air Sampling

Sampler Safety

- UC Davis Extension, Course: “Field Monitoring & Sampling of Hazardous Materials Notebook”, X. Health and Safety

Determination of Phenol by Gas Chromatography

- Hajian, Harry G. Sr. and Pecsok, Robert L., *Modern Chemical Technology*, Volume I, Prentice Hall, 1988. Chapter 2
- HMTRI, *Course HMT 260*, Pages 4:47-50
- U.S. EPA, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*; Volume 1, SW-846, method 8040, Environmental Protection Agency, September, 1986.

Schedule and Assignments

This module is designed for 2 hours of lecture.

Students should read the attached article “Life Is In The Balance” prior to Lesson 6.

Sampling and Analysis IV

Intent and Purpose

This is the final laboratory session in the Sampling and Analysis Unit, and it focuses on sample analysis by gas chromatography.

Laboratory Objectives

Successful completion of this laboratory will enable the student to:

1. **Understand** the basic theory behind gas chromatography.
2. **Perform** limited operation of a gas chromatograph.
3. **Understand** what information may be obtained from a chromatogram.

4. *Understand* the meaning of “matrix spike” and “retention time.”

Laboratory Outline

See Experiment Four

Suggestions for Development and Presentation

A pre-lab lecture/discussion on use of a gas chromatograph may be necessary. Students should be instructed on proper injection procedures.

As a post-lab, examples of chromatograms from other familiar substances may be discussed.

LABORATORY EQUIPMENT AND SUPPLIES:

EQUIPMENT REQUIRED:

SW-846, Method 8040 specifies the conditions for the detection of phenolic compounds. It suggests direct injection of from 2 to 5 uL samples, using the solvent flush technique.

The recommended column for underivatized phenols is: 1.8 m x 2.0 mm I.D. glass column packed with 1% SP-124ODA on Supelcoport 80/100 mesh or equivalent.

For underivatized phenols, set the nitrogen gas flow rate at 30

Set column temperature at 80° C and program an 8° C/min. temperature rise to 150° C; until all compounds have eluted.

The following equipment is required to perform this experiment:

Each Lab Station:

- Gas chromatograph, student grade
- Syringe, 2 to 5 uL
- Volumetric flask, 10 mL

Common Equipment & Supplies Available:

- Lab tissue
- Balance, analytical

REAGENTS REQUIRED:

The following reagents will need to be present in sufficient quantities to supply each lab station:

Phenol, crystals

(Only 0.05 g of phenol required per lab station.)

Sample #4: 30 mL of Chloraseptic/water solution

Chloraseptic throat spray may be purchased at any drug store. (It contains phenol and possibly sodium phenolate, reported as 1.4% total phenol, as its active ingredients.) Dilute 10 mL of Chloraseptic to 100 mL with DI water.

As a substitute, a 0.015 M phenol water solution could be used. (Chloraseptic is preferred due to its color and household familiarity.)

References and Resources

See Lesson 5

Schedule and Assignments

The student's guide for this experiment is attached to Laboratory 4 and should be read prior to this laboratory session.

This laboratory is designed to take three hours, including pre-lab.

Students should read the attached Risk Assessment Problem prior to the next laboratory session.

Assessment of Risks

Intent and Purpose

In this lesson, the concept of risk will be discussed from a site mitigation perspective, namely in the establishment of acceptable cleanup levels for contaminated sites.

Lesson Objectives

Successful completion of this lesson will enable the student to:

1. *Understand* why there are no standardized cleanup levels for contaminated soil.
2. *Appreciate* the complexity of risk quantification.
3. *Understand* how risk-based cleanup levels are calculated.
4. *Understand* how risk-based cleanup levels affect the choice of remedial actions.
5. *Assess* environmental risks relative to other risks.

Lesson Outline

1. Have students attempt to define "risk." (i.e. "probability of harm")

Environmental Technology

2. Have students attempt to develop criteria for acceptable levels of risk for contaminated sites. (i.e. “how clean is clean?”)
3. Explain the “ 1×10^{-6} excess cancer deaths per year” concept and its derivation.
4. Explain why there are standardized cleanup levels for drinking water, but not soil.
5. Lead a discussion based on a hypothetical situation as to how risk assessments may be used to establish cleanup levels and choice of remedial actions.
6. Lead a discussion comparing the 1×10^{-6} “rule” to other risks from events like smoking, driving, drinking alcohol, etc.
7. Lead a discussion as to the costs of risk reduction at contaminated sites. May such dollars be better spent reducing other, more substantial risks?

Suggestions for Development and Presentation

Risk is a subject tailor-made for in-class discussion, for it draws upon individual values and perspectives as to how far the government or property owners should go in protecting human health and the environment.

As such, the instructor should make every effort to extract a diverse set of views on risk and challenge each person to defend his/her position relative to those taken by others.

References and Resources

“Life Is In The Balance” by Elyse M. Rogers
EPA documents on Risk Assessments

Schedule and Assignments

This lesson is designed for 3 hours of classroom discussion.

Risk Assessment

Intent and Purpose

In this two-part laboratory, students will explore the application of risk assessments to determine appropriate cleanup levels and remedial technologies for contaminated sites. In Part I, students will (on an individual basis) assess the risks posed in a hypothetical situation, addressing a variety of issues and drawing a variety of conclusions. In Part II, students will form small groups and address the same issues and conclusions, only this time each group will be asked to reach consensus on such items.

Laboratory Objectives

Successful completion of this laboratory will enable the student to:

1. *Appreciate* the complexity of risk quantification.
2. *Appreciate* the role of value judgments in the risk assessment process.
3. *Derive* risk-based cleanup levels.
4. *Employ* risk assessments in the selection of appropriate remedial technologies.
5. *Recognize* that risk assessment is an “art” as well as a “science.”

Laboratory Outline

Part I

Students should have read the entire Risk Assessment Problem prior to this laboratory session; otherwise the student will not be able to complete Part I within the three hour time frame.

The Risk Assessment Problem is self-explanatory. Throughout the Problem, students are asked to address a number of issues. The instructor may select some or all of such issues for the students to respond to, in writing, by the end of the laboratory period. Similarly, the Problem asks students to consider a number of conclusions. Students should be required to address all such conclusions, in writing, by the end of the laboratory period.

The instructor should collect such written responses, grade them, and return them to the students prior to Part II.

Part II

Divide students into small groups and ask that each group address the same issues and conclusions presented in Part I, but to formulate group responses to such issues and conclusions. Students should be instructed that these group responses must represent a consensus of group members.

The responses of each group should be in writing and given to the instructor prior to the end of the laboratory session.

Suggestions for Development and Presentation

In reality, preparation and use of risk assessments is extremely complicated. As such, to be consistent with the objective of training technician-level employees, this laboratory exercise is very much oversimplified; however, it does provide the student with an appreciation of major issues encountered with risk assessments.

Each small group should be composed of 4-5 students. Groups with fewer than 4 students tend to not generate a diverse set of perspectives. Conversely, groups of six or more makes consensus among group members very difficult, thereby making it unlikely that all issues and conclusions will be addressed within the three hour time period.

References and Resources

See Lesson 6

Schedule and Assignments

This laboratory is designed to take six hours to complete (three hours per session)

Students should complete Lesson 7 prior to the next laboratory session.

Environmental Reports

Intent and Purpose

All too often, the importance of communication, especially through environmental reports, is overlooked in managerial and technician-level training courses. In this lesson, the purpose, preparation, and use of environmental reports is presented with a focus on emphasizing the importance of clear and accurate communication of technical environmental information.

Lesson Objectives

Successful completion of this lesson will enable the student to:

1. **Know** what types of environmental reports are commonly prepared in the hazardous substance industry.
2. **Appreciate** the importance of communicating technical information clearly.
3. **Recognize** the different audiences to which environmental reports are directed.
4. **Understand** the importance of environmental reports as legal documents.
5. **Know** the basic format of most environmental reports.
6. **Understand** the ethics in accurately reporting environmental information.
7. **Comprehend** laboratory reports.
8. **Comprehend** boring logs.

Lesson Outline

1. Review the most common types of environmental reports: Phase I Environmental Assessments, RI Reports, FS Reports, and RAPs.
2. Explain that the report author, not the recipient, bears the burden of proper communication.
3. Explain the importance of clearly distinguishing between fact and opinion.
4. Identify common audiences for reports: the layperson client, regulatory agencies, attorneys, and the general public.

5. Explain the role of environmental reports as legal documents, reflective of both the author's technical competence and the client's knowledge.
6. Explain the general format of most environmental reports and the reasons for such format: Executive Summary, Procedures, Results, Analyses, Conclusions, Recommendations, Limitations, and Appendix Materials such as laboratory results, diagrams, boring logs, chain-of-custody documentation, etc.
7. Explain the necessity of accurately reporting "bad news" despite the client's desire to do otherwise. Stress the legal liability and loss of credibility of a report writer who allows his/her professional judgment to be compromised.
8. Distribute some examples of typical laboratory reports and explain how to interpret them.
9. Distribute an example of a boring log and explain how to interpret it.

Suggestions for Development and Presentation

Experience indicates that this lesson is best taught using real-life examples of poor report writing and actual laboratory reports and boring logs. Students seem to understand the concepts of this lesson better by learning what types of problems to avoid.

References and Resources

Teaching materials for this lesson are left to the discretion of the instructor.

Files of regulatory agencies contain an abundance of excellent teaching materials, and they are public documents.

Schedule and Assignments

This lesson is designed for 2 hours of lecture/discussion.

No further assignments are warranted since this lesson is the final one of the Module.

Critique of Environmental Report

Intent and Purpose

In this two-part laboratory, students will review and critique an actual Phase 1 Environmental Assessment using the proposed ASTM Due Diligence Standards as a guide.

Laboratory Objectives

Successful completion of this laboratory will enable the student to:

1. **Recognize** the common components of an environmental assessment.
2. **Understand** the importance of clear and accurate report preparation.

3. *Critically* review basic components of environmental reports.

Laboratory Outline

Part I

In the first three-hour session, students will compare the Facility Environmental Assessment presented in Lesson 6 to the proposed ASTM Due Diligence Standards (attached) and develop a list of areas in which the Environmental Assessment is deficient.

Part II

In the second three-hour session, students will answer the questions on the attached Worksheet.

Suggestions for Development and Presentation

A pre-lab lecture as to why a seller of property should prepare an environmental assessment may be necessary. In addition, a brief discussion as to the need for standardization of environmental assessment criteria may also be helpful.

References and Resources

Attached ASTM Due Diligence Standards (proposed)

Facility Environmental Assessment attached to Lesson 6.

Schedule and Assignments

This laboratory is designed to be completed in two 3-hour sessions as noted in the above Laboratory Outline.

Hazardous Materials Awareness & Safety

Instructor's Guide

Prepared By:

Ann Boyce
Bakersfield College
1801 Panorama Drive
Bakersfield, CA 93305
(805)395-4552

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Preface

This is the instructor's guide for a module entitled *Hazardous Materials Awareness and Safety*.

This module is part of *Safety and Emergency Response*, a 4 unit lecture/laboratory core course in the EHMT Associate Degree and Certificate Program. The course is designed to provide students with hands-on instruction in safety and emergency response to chemical and physical exposures in industrial and field settings. It is designed to satisfy the requirements for generalized employee training under OSHA (1910.120).

The course has been divided into three modules:

- Module I Hazardous Materials Awareness and Safety
- Module II Spill Control and Emergency Response
- Module III Decision Making in Emergencies

This modularization has been designed in such a way that the course can be taught as three separate "mini-courses." Modules II and III are each 45 hours and therefore represent 1.5 lecture/lab units (7 lessons and 7 labs each account for 42 hours, the remaining three hours are for finals and other tests, etc.). Module I is 24 hours (out of necessity since it is designed to satisfy the OSHA Hazardous Waste Worker 24 hour training requirement) so can be taught as a 1 unit course.

Modularization will allow the maximum flexibility for individual colleges to meet both traditional educational goals **and** the immediate needs of local industry. This flexibility is evidenced by the following available options:

- Modules can be used for Contract Education (in whole or part)
- Modules can be used for Community Service Classes (in whole or part)
- Modules are Degree and Certificate Applicable

The lab exercises have also been designed with this flexibility in mind. Each lesson plan is for one week, or three hours, of lecture time. Associated with each lesson is a three hour lab exercise. Lab exercises can be taught either in a separate three hour lab period **or** can be alternated with lecture topics in an integrated course approach.

Note to Instructors: It is suggested that the instructor using this module read through **all** lessons and labs prior to starting the course. In this way, later concepts which are built on earlier activities can be better anticipated and planned for.

Overview of Hazardous Waste Operations

Intent and Purpose

In this lesson, the hazards involved in work related to hazardous waste site operations will be covered. Characteristics of a “hazardous waste” versus a “hazardous material” will be reviewed as well as applicable agency involvement and general terminology.

The broad spectrum of hazards associated with both hazardous waste and hazardous materials handling will be emphasized.

It is important to cover some basic measurement and chemical and physical principles in this lesson in order that subsequent lessons will be understood. Examples include concepts such as ppm, ppb, vapor density, vapor pressure, specific gravity, flash point, and flammability range.

Lesson Objective

To successfully complete this lesson, the student will be able to:

1. **Explain** what a hazard is and relate the term to the types of work done by both hazardous materials and hazardous waste workers.
2. **Describe** in general terms the laws and agencies involved in hazardous materials and hazardous waste regulation.
3. **List and define** the four characteristics of a hazardous waste.
4. **Describe** five hazards that are of concern to the hazardous materials worker.

Lesson Outline

1. If desired, a “Skills Survey” can be given before actual instruction begins. Selected basic questions about the material to be covered can be compiled by the instructor for this purpose. This can be beneficial because it lets the instructor know the level of understanding by the students **prior** to instruction and it gives the students a better feel for what they will be expected to know **after** instruction.

2. Major hazards of hazardous materials and waste worker operations should be discussed, including:

Exposure to:

- Corrosive materials
- Toxic materials
- Explosive and reactive compounds
- Flammable materials
- Biologically active materials
- Radioactive materials

Injuries:

- Slips and falls
- Lifting
- Moving objects/equipment
- Cuts or injections by sharp objects

Health hazards:

- Confined spaces
- Oxygen deficient spaces
- Electrical hazards
- Heat stress
- Noise

3. Activities engaged in by hazardous materials workers

- Transportation
- Handling and use
- Storage/disposal
- Site clean-up

4. What is a hazardous waste?

Characteristics:

- Toxicity

Environmental Technology

- Reactivity: include discussion of the possible effects of mixing two or more chemicals
- Corrosivity: include discussion of pH scale
- Ignitability: include discussion of flash point and flammability ranges

Listed wastes

- General definition of a waste as “a material for which there is no further use intended”

5. General Terminology

- Hazardous material
- Waste
- Hazards (health and safety)
- Risk
- Accident
- Incident

6. Major federal and state laws

Suggestions for Development and Presentation

Since this module may be the only hazardous materials course taken by some students, it is important to cover in a very basic way, the “big picture” in terms of regulation, necessity for training, and understanding of the various groupings of hazards involved in the work done with hazardous materials/wastes.

Major terms must be added to their vocabulary for effectively understanding subsequent lessons.

It may be effective to discuss the various work activities that involve hazardous materials or hazardous waste and enumerate hazards (possibly prioritizing) that are involved.

FEMA has several slide programs that address transportation and work site hazards.

Resources and References

Major Hazards of Hazardous Materials:

- HMTRI, *Course HMT 210*, Lesson 1, pages 1-12 through 1-17.
- HMTRI, *Course HMT 240*, Lesson 3, pages 3-50 through 3-82.
- FEMA, *Identifying and Recognizing Hazardous Materials*, Text, workbook, and slide presentation.

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments are as follows:

- Handouts prepared by the instructor on the characteristics of a hazardous waste, waste classifications, and terminology.
- Textbook, Chapters 1 and 2.

Hazard Recognition and Classification

Intent and Purpose

In this laboratory exercise, the student will have the opportunity to explore the ways to recognize and classify hazards. Students will learn that recognition goes hand-in-hand with evaluation of the hazard potential. Part of the exercise will involve clues as to the presence of hazardous materials.

All exercises in this course will emphasize inductive rather than deductive reasoning for hazard recognition and prevention. Interrelationships will also be stressed, as a hazard is basically a relationship between man, machine or material, and environment.

Basic topics in fire chemistry will be covered as well as classes of unstable materials.

Laboratory Objectives

1. **List** the six clues to the presence of hazardous materials.
2. **Describe** the hazards that the major hazardous materials classifications represent.
3. **Interpret** the physical and chemical data that one would find in resources such as Sax, *Dangerous Properties of Industrial Materials* or on an MSDS.
4. **Describe** the possible effects of mixing two chemicals together.

Pre-Lab Outline

Discuss the following:

1. The difference between inductive and deductive reasoning as they pertain to hazard recognition.
 - Relate to the safety professional's use of "Job Hazard Analysis."
 - Describe the nature of hazards (interrelationship between man, machine or material, and environment) that provides opportunity to use inductive reasoning.

2. Clues for detecting hazardous materials presence:

- Occupancy and/or location
- Container shapes
- Marking and colors
- Placards and labels
- Shipping papers
- Senses

3. Some of the major hazardous material classes are defined:

- Explosives: any chemical compound, mixture, or device which functions by the instantaneous release of gas and heat.
- Flammable gas: compressed gases meeting certain criteria for lower flammability limit, flame projection, or flame propagation.
- Combustible liquid: any liquid having a flash point at or above 100 degrees F.
- Flammable liquid: any liquid having a flash point below 100 degrees F.
- Flammable solid: any solid material other than an explosive which is liable to cause fires through friction or retained heat from manufacturing or processing; includes spontaneously combustible materials and water-reactive materials.
- Organic peroxide: an organic compound containing the bivalent o-o structure. It may be considered a derivative of hydrogen peroxide where one or more of the hydrogen atoms have been replaced by organic radicals.
- Oxidizer: a substance such as chlorate, permanganate, inorganic peroxide, or a nitrate, that yields oxygen readily and accelerates the combustion of organic matter.
- Poisons: materials that are toxic to varying degrees (A versus B poisons).
- Etiologic agent: living microorganism (or its toxin) which causes (or may cause) human disease.
- Radioactive material: material that spontaneously gives off ionizing radiation.
- Corrosive material: any liquid or solid that causes visible destruction or irreversible damage to human skin tissue or has severe corrosion rate on steel.

4. Discuss classes of unstable materials

- Peroxides

- Peroxidizables
- Water reactives

Laboratory Exercise

1. Detecting Hazardous Materials Presence

Show slides of various potential clues for the presence of hazardous materials as discussed in the pre-lab and have students determine:

- Whether they believe hazardous materials are present
- Why they said “yes” or “no”

For this exercise, pre-packaged slides such as those in the FEMA Program, *Recognizing and Identifying Hazardous Materials*, can be used or the instructor may elect to put together his or her own set. Just be sure there are a variety of industrial settings depicted as well as consumer products vendors, transportation units with and without labels or placards, and settings showing environmental damage.

2. Job Hazard Analysis

The concept of a “Job Hazard Analysis” as performed by safety professionals should be explained to students. The class should be divided into small groups of 4 or 5 students or less. Each of these groups should discuss a work activity that involves one or more hazardous materials. For the work activity selected, each group should discuss and complete a “Job Hazard Analysis” for at least three steps of the job. The analysis must contain:

- At least three steps of the job broken down and described
- **All** hazards (both safety and health) associated with the steps identified
- **All** pertinent physical and chemical characteristics available for the material involved. A variety of references should be made available in the classroom for this activity. This is to ensure that students understand flash point, flammability ranges, specific gravity, etc.

Each group should make a short presentation to the class that describes the “Job Hazard Analysis” they conducted. Input from the rest of the class should be sought to make sure all hazards were identified.

Suggestions for Development and Presentation

This laboratory exercise gives the students an opportunity to **review and apply** concepts and terminology covered in Lesson 1 and the Pre-Lab for this exercise.

Prior to assigning the “Job Hazard Analysis” exercise, it is advisable to review a hypothetical one with the class. In this way, they will better understand the goals of the project.

References and Resources

Environmental Technology

See Lesson 1 resources

“Job Hazard Analysis”:

- See OSHA document attached.

Schedule and Assignments

This laboratory is suggested to take 3 hours of classroom time.

Laboratory reports on “Job Hazard Analysis” should be turned in by work groups at the end of this session.

Health Effects of Hazardous Substances

Intent and Purpose

This lesson covers basic toxicological concepts and relates them to industrial hygiene at the work site. The student will learn how to interpret terms such as LD₅₀, PEL, TLV, and Routes of Exposure to evaluate and enhance worksite safety.

Coverage of routes of exposure will include an overview of the function of the respiratory system, the skin, and the bloodstream as they pertain to absorption, distribution, and elimination of hazardous substances. The role of oxygen will be stressed.

The student should understand how the states of matter affect the potential routes of exposure.

Lesson Objective

To successfully complete this lesson, the student will be able to:

1. **Describe** the main routes of exposure by which toxic chemicals can enter the body.
2. **List** the major routes of excretion of toxic chemicals from the body.
3. **Explain** what LD₅₀ is and how it relates to relative toxicity.
4. **Describe** the difference between aerosols and gases.
5. **List** the three ways by which asphyxiation can occur.
6. **Define** tumor, carcinogenic, teratogenic, and mutagenic.

Lesson Outline

1. Explain what toxicology is and relate to term “toxic”.

2. Discuss the meaning of the following terms:

- LD₅₀ (including relative toxicity ratings)
- NOEL
- Dose-Response
- Acute
- Chronic
- TLV
- PEL
- IDLH
- STEL
- Carcinogenicity
- Mutagenesis
- Teratogenesis

3. The routes of exposure are described along with their relative significance for the hazardous materials worker:

- Inhalation: most common, generally quickest to bloodstream (large surface area of alveoli and two cell wall barrier)
- Dermal Absorption: lipid solubility of many compounds.
- Ingestion: least common— generally avoided through good hygiene practices.

4. Introduce the function of the respiratory system including:

Three levels of gas exchange:

- Surrounding air to the lungs
- Lungs to the blood
- Blood to individual cells

Some major components of the pulmonary system:

- Mucous membranes of nasal passages and pharynx

Environmental Technology

- Bronchial tree
- Alveoli

5. Introduce the function of the circulatory system, including:

- Oxygen transport
- Effect of pulse rates and breathing rates

6. Oxygen levels necessary to sustain life:

- 21-16% Nothing abnormal
- 16-12% Loss of peripheral vision, increased breathing volume, accelerated heartbeat, impaired attention and thinking, impaired coordination
- 12-10% Very faulty judgment, very poor muscular coordination, muscular exertion causes fatigue that may cause permanent heart damage, intermittent respiration.
- 10-6% Nausea, vomiting, inability to perform vigorous movement, or loss of all movement, unconsciousness, followed by death.
- <6% Spasmodic breathing, convulsive movements, death in minutes.

7. The three ways by which asphyxiation can occur:

- Concentration of oxygen too low (falls below 16%)
- Air passages physically blocked (strangulation and choking)
- Chemical asphyxiation (oxygen transfer is blocked)

8. The difference between aerosols (fine particulates) and gases.

Suggestions for Development and Presentation

There are several excellent videos that can be used to tie this lesson in with the previous lesson on chemical and physical characteristics. Coastal Films has a film entitled *Chemical Safety* that covers all the concepts in these two lessons.

References and Resources

- HESIS, *Understanding Toxic Substances, An Introduction to Chemical Hazards in the Workplace*, available from HESIS, Berkeley, CA. A copy is provided in the attachments for this lesson.

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments are as follows:

- Handouts on basic toxicological and industrial hygiene concepts such as the HESIS pamphlet entitled, *Understanding Toxic Substances...*

Applications of Hazard Recognition and Work Site Safety

Intent and Purpose

This laboratory will reinforce concepts covered in the previous lessons and lab and will allow the student to explore applications of material learned.

To accomplish this, the student will be introduced to common resource and reference material giving information on chemical and physical characteristics of materials as well as toxicological and industrial hygiene information.

The student will learn to use the *NIOSH Pocket Guide to Chemical Hazards*, *ACGIH TLV's and Biological Indices*, and selected entries in Irving Sax' *Dangerous Properties of Industrial Materials*. Using these sources, the student will make decisions about common hazardous materials in the work place.

This laboratory session will also give the student the opportunity to read and apply a portion of the regulations in Title 8 of the *California Code of Regulations* pertaining to trenching.

Laboratory Objectives

To successfully complete this exercise, the student will be able to:

1. **Interpret** information given in common resource materials and apply it to work place practices.
2. **Explain** the potential hazards of trenching operations and applicable regulatory requirements to prevent them.
3. **Conduct** a Job Hazard Analysis on a typical work site activity for a hazardous materials worker.
4. **Determine** whether a chemical's vapors would be expected to rise or sink to low spots and whether a material would float or sink in water based on chemical characteristic information.

Pre-Lab Outline

Review the use of NIOSH's *Pocket Guide to Hazardous Materials* and ACGIH's *TLV's and Biological Indices*.

Laboratory Exercise

1. Pass out the "MSDS Worksheet" and MSDS on Methyl Ethyl Ketone. Allow students time to individually complete the worksheet then discuss in class to make sure they understand all the concepts.

Environmental Technology

2. Have students conduct a Job Hazard Analysis on cleaning a toluene tank. They should only be required to fill in the first two columns at this stage (omit the “new procedure and risk reduction” column) since this laboratory will be completed and refined during the final lab session. This exercise incorporates the ability to interpret information given in the resource and reference materials discussed in the pre-lab and prepares the student for the confined space presentation in a later lesson.

The students should be told that their supervisor has requested that they clean out a previously emptied 10,000 gallon toluene tank. The tank has an 18" manway on top. Students are to perform their analyses on the blank form provided as part of the attachments for Lab #1.

3. Trenching Exercise:

Pass out short section of Title 8 Trenching Safety Regulations along with the “You Be The Inspector” scenario. Tell students to carefully read the regulations and the scenario and, in groups of 4 or 5, determine:

- a) **All** potential violations (written in enforcement format; e.g. failure to ...)
- b) **All** definite violations (also written for enforcement)
- c) Ask each group to report violations and give pertinent sections of regulations. Compile on the blackboard a class synopsis of both sets of violations.
- d) Tell students they are now to “change hats” and they will be judges as this case is taken to the courtroom. Pass out the “You Be the Judge” sheet and give groups some time to come to a consensus on the verdict for each of the counts the class as a whole agreed on.
- e) Discuss how each group arrived at their decisions on verdict then read the actual outcome in the case. Explain that the scenario was embellished somewhat but that it was taken from an actual OSHA enforcement case. Read the actual judge’s verdict.

Suggestions for Development and Presentation

It is important not to give too much information when presenting the trenching exercise so as to let students discuss among themselves interpretation of the regulations and the information given in the scenario.

The same holds true for the toluene tank exercise. This will prepare the students to compare how the Phoenix Tank Explosion could have been prevented.

References and Resources

The instructor should refer to the “Job Hazard Analysis” pamphlet developed by OSHA and supplied as an attachment for Lab 1 for an example of an analysis on a toluene tank.

Schedule and Assignments

This laboratory is suggested to take 3 hours of classroom time.

Laboratory reports should be turned in at the end of this laboratory session. The Job Hazard Analysis will be returned for completion at a future lab session.

Health and Safety Planning

Intent and Purpose

In this lesson the importance of development and implementation of adequate plans prior to performing any work onsite is stressed. The student will also learn how to integrate the use of monitoring equipment into the field decisions that make planning documents dynamic instruments.

The lesson will cover overall site safety plans as well as individual components such as Job Safety Plans, Emergency Response Plans, and Sampling Plans.

Use of appropriate field monitoring equipment will include the PID (HNu), Combustible Gas Indicator, Oxygen Meter, and Colorimetric Indicator Tube System. Students will learn what the instrument readouts mean, instrument limitations, hazards monitored by each, and inherent safety issues associated with each.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Explain** the difference between qualitative and quantitative monitoring.
2. **Describe** what an oxygen meter, Photoionization meter, combustible gas meter, and Colorimetric Tube Indicator System are used for (what they detect) and their applicability to hazardous waste work.
3. **Explain** the difference between site safety plans, emergency response plans, and sampling plans for hazardous waste operations.
4. **Analyze** a Sampling Plan and identify the considerations that must be made in the development of an accompanying Site Safety Plan.
5. **Explain** the purpose and importance of site control.

Lesson Outline

1. Monitoring Instruments

Photoionizing Detector (HNu):

- Hazard Monitored
- Applications
- Components
- Detection Methods
- Readout
- Calibrations

- Inherent Safety
- Limitations

Combustible Gas Indicator:

- Hazard Monitored
- Applications
- Components
- Detection Methods
- Readout
- Calibrations
- Inherent Safety
- Limitations

Oxygen Meter:

- Hazard Monitored
- Applications
- Components
- Detection Methods
- Readout
- Calibrations
- Inherent Safety
- Limitations

Colorimetric Indicator Tube System:

- Hazard Monitored
- Applications
- Components
- Detection Methods

- Readout
- Calibrations
- Inherent Safety
- Limitations

2. Planning for Health and Safety

Definitions

- Decontamination— the process by which chemical contaminants are removed from the body. This process may include cleaning or removing and discarding protective clothing.
- Reportable Quantities — An amount of chemical that has been leaked or spilled that triggers a reporting to certain state, federal, or local agencies.
- Site Control — the process by which activities and personnel are organized and directed during site operations. Site control is required during both routine operations and emergency operations.
- Chain of Custody — a method of ensuring that laboratory samples are kept intact during transport from site to the laboratory. Provides a means of tracing samples back to all the individuals that actually handled the samples during the transport.
- Mitigation — bringing an emergency situation to a controlled status; the procedures used to bring a situation under control.
- Up or Down Grading— increasing or decreasing the amount of personal protective clothing required to be worn for a task.

Site Safety Plan

- Synonym (Health and Safety Plan)
- Purpose and use
- Main components
- Purpose and use
- Main components

Job Safety Plan

- Purpose and use
- Main components

Emergency Response Plan

- Purpose and use
- Main components

Suggestions for Development and Presentation

This lesson requires the demonstration of field monitoring equipment, such as Combustible Gas Indicators, Oxygen meters, Colorimetric Tube Systems, and Photoionization detectors. If the college does not possess this equipment it should be rented or borrowed for this lesson. Local fire or health agencies may help out by sending their equipment with a representative to discuss how it is used.

The instructor can rely more on the textbook starting at this point in this module. Unfortunately, the text assumes that the reader has quite a bit of foundational information so cannot be used exclusively in the early lessons.

References and Resources

- Textbook, Chapters 3, 6, 7, and 9

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments are as follows:

- Textbook, Chapters 3, 6, 7, and 9

Personal Protective Equipment and Decontamination

Intent and Purpose

This laboratory will introduce the student to the decision logic used to select appropriate personal protective equipment for the work to be done. Students will first learn what PPE is, what the various levels are used for, and limitations of its use.

In learning about PPE, the emphasis will be on correct selection based on certain decision logic. The student will use information presented in this lab to make selection decisions.

Students will also learn proper care and maintenance of equipment as well as appropriate decontamination procedures.

Laboratory Objectives

To successfully complete this exercise, the student will be able to:

1. **Select** the proper full ensemble of personal protective equipment based on the EPA A,B,C,D Classification System.
2. **Utilize** the decision logic commonly used to determine personal protective equipment for specific chemical levels and environmental situations.
3. **List** the critical factors in selection and use of PPE as they affect worker health, safety, and performance.
4. **Identify** the different PPE by shape, size, fit, color, and function.
5. **Set up** a proper decontamination system.

Pre-Lab Objectives

1. Explain what PPE is used for.
2. Performance Requirements

Chemical resistance:

- Degradation
- Penetration
- Permeation
- Chemical Resistance and Permeation Charts
- Butyl Rubber
- Chloropel
- Natural Rubber
- Neoprene
- Nitrile
- Nomex
- Polyethylene
- Polypropylene
- Poly-Coated Tyvek
- PVA
- PVC

- Saranex
- Tyvek
- Viton

3. Types of Protective Clothing

- Head Protection
- Eye Protection
- Ear Protection
- Skin Protection

4. Types of Respiratory Protection

- Dust Masks
- Cartridge and Canister Air-Purifying Respirators
- Air-Supplying Respirators (SCBA and Airline)
- Escape-only systems

5. Decision Logic for Respiratory Protection

- Protection Factors
- Oxygen
- Warning Properties
- Maximum Use Limits

6. Inspection, care, and maintenance of PPE.

- Chemical Protective Suits
- Respiratory Protection Equipment

7. Developing a PPE Program

Laboratory Exercise

1. Assign small groups of students a chemical to research for this exercise. Each group can be assigned a different chemical. The students are to decide at what concentrations of the chemical they would use A, B, C, and D levels of PPE, and **why**. Give each group a couple of situations where they might hypothetically find this chemical, such as, a spill in a small laboratory or as a soil contaminant from an underground tank removal. This will require them to take into account whether an oxygen deficient atmosphere may present a problem.
2. Have equipment available for rotation through the groups. Have each group fully inspect suits and other equipment. Have them check monitoring equipment for calibration and maintenance. Groups should then develop procedures and timelines for care of suits and equipment.

Suggestions for Development and Presentation

The pre-lab discussion is crucial for success in this laboratory. Be sure to thoroughly cover basic decision logic for use of supplied air respirators versus air purifying respirators. Go through a couple of practice exercises with the class prior to letting them start the exercises to ensure that they fully understand steps to be taken to make these types of decisions.

Explain the exercise thoroughly and work out a method so that equipment/monitoring devices can be rotated through class groups so all students will get an opportunity to do Exercise #2 for this lab.

References and Resources

- Miscellaneous equipment catalogs for information on PPE degradation, permeation, and penetration.
- Textbook, Chapters 8 and 10
- NIOSH, *Pocket Guide to Chemical Substances...*
- ACGIH, *TLV's...*
- Additional handouts on Odor Threshold, etc.

Schedule and Assignments

This laboratory is suggested to take 3 hours of classroom time.

Student reading/study assignments are as follows:

- Textbook, Chapters 8 and 10
- Handouts compiled by instructor

Regulatory Compliance for HazMat Worker Health and Safety

Intent and Purpose

In this lesson, the student will learn about basic health and safety rights of workers granted under OSHA law. Right-to-Know laws and their requirements will be covered including California's Hazard Communication Standard and federal OSHA's Hazardous Waste Operations and Emergency Response Regulations (*CFR 29, 1910.120*).

Both training requirements and disclosure requirements of these laws will be stressed. Students will also gain an understanding of the relationship of enforcement agencies such as OSHA to research, testing, and certification entities such as NIOSH.

The scope of the General Industry Safety Orders will also be addressed.

Lesson Objective

To successfully complete this lesson, the student will be able to:

1. **Describe** basic health and safety rights and protections under OSHA.
2. **List** four areas that the General Industry Safety Orders require training in for safe work practices.
3. **Explain** the scope and general requirements of California's Hazard Communication Regulation.
4. **Describe** the scope and general requirements of *CFR 29, 1910.120*, the Hazardous Waste Operations and Emergency Response regulation.
5. **List** 5 typical training elements required under *CFR 29, 1910.120*.

Lesson Outline

1. Discuss basic health and safety rights under OSHA.

- Workplace free of health and safety hazards
- File complaint with OSHA, and remain anonymous, if desired
- OSHA inspection of the workplace when unsafe or unhealthy conditions are suspected.
- See publicly posted notices of OSHA citations for health and safety violations.
- Right to refuse unsafe work (conditional)
- Protection from discrimination or retaliation.

2. Right to Know Laws

- Access to exposure and medical records
- Hazard Communication Standard
- NLRA Section 8(a)(5)

3. Functions of NIOSH

- Health Hazard Evaluations
- Respirators, PPE, and Monitoring Equipment Information
- Technical Documents

4. Employee Training

- GISO
- Federal and California Hazard Communication Standards
- MSDS's
- 29 *CFR*, 1910.120 and 1910.121 (subject matter requirements, hours for onsite/offsite training, scope)

Suggestions for Development and Presentation

The material in this unit can be confusing to the student due to overlapping requirements for training. It is suggested, therefore, that the instructor use case studies (hypothetical or real) to walk the student through the various requirements.

Resources and References

Federal and Cal-OSHA have a number of pamphlets and leaflets on the subject of employee rights and training. Several are provided in the attachments for this lesson and should be duplicated, as needed, for students.

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom time.

Student reading/study assignments are as follows:

- Textbook, Chapters 4 and 5

Spill Control and Emergency Response

Instructor's Guide

Prepared By:

Richard Casagrande
RAM Environmental Engineering and Training
3333 Gibson Street, Ste. 200
Bakersfield, CA 93305
(805) 324-6152

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Preface

This is the instructor's guide for a module entitled *Spill Control and Emergency Response*.

This module is part of *Safety and Emergency Response*, a 4 unit lecture/laboratory core course in the EHMT Associate Degree and Certificate Program. The course is designed to provide students with hands-on instruction in the *applications* of safe hazardous materials handling and response to emergencies.

The course has been divided into three modules:

- **Module I Hazardous Materials Awareness and Safety**
- **Module II Spill Control and Emergency Response**
- **Module III Decision Making in Emergencies**

This modularization has been designed in such a way that the course can be taught as three separate "mini-courses." Modules II and III are each 45 hours and therefore represent 1.5 lecture/lab units. Module I is 24 hours so can be taught as a 1 unit course.

Modularization will allow the maximum flexibility for individual colleges to meet both traditional educational goals **and** the immediate needs of local industry. This flexibility is evidenced by the following available options, since the modules can be used in whole or part for:

- **Contract Education**
- **Community Service Classes**
- **Degree and Certificate Applicability**

The lab exercises have also been designed with this flexibility in mind. Each lesson plan is for one week, or three hours, of lecture time. Associated with each lesson is a three hour lab exercise. Lab exercises can be taught either in separate lab periods **or** can be alternated with lecture topics in an integrated course approach.

Spill Control and Emergency Response

Module Description

This module is comprised of 45 lecture/laboratory hours covering the following aspects of spill control and emergency response:

- Selection of Appropriate Chemical Protective Clothing
- Selection of PPE for Respiratory Protection
- Decision Logic for EPA Levels A, B, C, D
- Decontamination Methods
- Site Control and Containment
- Handling Drums and Other Containers
- Use of Field Exercises

Specific objectives are listed for each of the 7 lessons and 7 laboratory exercises described in this module.

Texts

A Syllabus Should be Made Using Appropriate Excerpts from:

EPA, *Hazardous Materials Response for First Responders*, available through the American Council of Governmental Industrial Hygienists, Publications Office, 6500 Glenway Ave., Bldg D-7, Cincinnati, OH 45211.

NIOSH, *Personal Protective Equipment for Hazardous Materials Incidents: A Selection Guide*, available through the American Council of Governmental Industrial Hygienists, see previous citation for address.

NIOSH, *Guide to Industrial Respiratory Protection*, available through the U.S. Government Printing Office.

NIOSH, *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, available through the U.S. Government Printing Office.

Instructor Resources and References are described within this document.

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Introduction to the Selection of Chemical Protective Clothing

Intent and Purpose

This lesson will provide a framework of the decision logic that used to choose appropriate clothing to protect workers in hazardous materials environments. A discussion on C.P.C. availability and use is included.

Students will learn the OSHA Standards that require personal protective clothing. They will also be taught industry's testing methods as found in ASME and NFPA and NIOSH. The quality of vendor tests, methods for testing, uses and challenges to which C.P.C. may be subjected in a working environment are important elements in the C.P.C. selection logic.

Students will be instructed in the different factors that affect the rate of permeation, breakthrough time, durability, flexibility, and ease of decontamination. The resistance of C.P.C. to permeation, degradation and penetration will be discussed, as well as C.P.C. resistance to chemical groups.

Lesson Objectives

To successfully complete this lesson the student will be able to:

1. **Define** the various industry tests and their use in C.P.C. selection.
2. **Describe** the differences in economical clothing that is most appropriate for the type of incident or emergency, whether minor or very advanced, where exposure to chemicals is possible.
3. **Describe and defend** the logic used for C.P.C. selection in different applications for different groups of chemicals.
4. **Explain** the terms degradation, permeation, and penetration as it applies to C.P.C. use.
5. **Describe** the various C.P.C. materials and their resistance to groups of chemicals.

Lesson Outline

1. Discussion of different standards, i.e., OSHA, MSHA.
2. Discussion of permeation and chemical degradation.
3. A discussion of the types of suits and how they are made from different materials.
4. An interpretation of the different tests that the manufacturer performs.
5. Discuss OSHA Standards for the use of Personal Protective Equipment on Page 2-33 of the *Emergency Response II Course*, Student Guide gray book, this Section is also included in the EPA Manual, so it is fully copied as to its entirety.
6. Specific methods to be used, pros, cons, availability, estimated costs.

Environmental Technology

Through the demonstration of the common types of personal protective equipment, specifically gloves, and full suits, the instructor will be able to show the student the evolution and historical background for chemical protective clothing, including aprons and gauntlet gloves.

Each student will be provided vendors charts, testing criteria, discussion of compatibility, permeation, degradation, and other elements that are appropriate to determine the specific CPC to be used.

A timely analysis is based on the full text of all OSHA appropriate laws and the standards that are being currently promulgated in the Federal Register as to the standards for chemical protective clothing. Special discussion on radiation and special protective equipment therein completes the lesson.

Suggestions for Development and Presentation

Selected videos and slides of Personal Protective Equipment for all the elements mentioned in the Course Outline.

The vendors list of permeation rates.

Lectures:

A demonstration of the vast array of Personal Protective Equipment (PPE) and Chemical Protective Clothing (CPC) such as, gloves, boots, goggles, hearing protectors, and chemical protective clothing from Level D through Level A.

Emphasis must be on the effective use of chemical protective clothing, to protect the wearer and not compromise the wearer's health and safety. Emphasis should be on determining the appropriate level of protection required for the assigned task.

Cost and availability should be stressed, because these are the factors in the field that will help determine the kind and type of protection that is used.

The instructor should thoroughly cover each broad group of chemicals and their compatibility with C.P.C., (organo chlorines, solvents, acids, bases, extremely toxic materials and acid gases). Also, each chemical group is used as an example to chart out the protection afforded the wearer for each type of suit of chemical protective clothing and how it will perform for the worker. The NIOSH book should be utilized and the terminology therein be fully explained along with all of the acronyms appropriate for the CPC in a discussion phase with the students.

References and Resources

- NIOSH/OSHA/USCG/EPA - *Occupational Safety at Hazardous Waste Sites*
- NIOSH - *P.P.E. for Hazardous Materials Incidents: A Selection Guide*
- *EPA Response Safety Decision Making*, Parts 1, 2, 3, 4, & 5.

Schedule and Assignments

All equipment and C.P.C. should be in the class prior to lecture; manufacturers charts and chemical compatibility should be available to each student.

Developing a PPE Program

Intent and Purpose

The purpose of personal protective clothing and equipment PPE is to shield or isolate individuals from the chemical, physical and biological hazards that may be encountered at hazardous waste sites or emergencies. Careful selection and use of adequate P.P.E. should protect the respiratory system, skin, eyes, face, hands, feet, head, body and hearing.

The intent of this lab is to describe the various types of PPE in a program that is required by law. The approach is to discuss the seven factors which distinguish successful safety programs and safety performance in industry and to use information on assembling the different levels of personal protective clothing and tie that in with the task at hand, whether it be a simple or complex operational task.

The approach for this laboratory exercise on chemical protective clothing and personal protective equipment is to have the students review the definitions discussed and have manuals and vendors books on the permeation rates. Instruction on how to interpret the data from the manufacturers using each type of material is demonstrated and applied. Using this information, the student will develop the “skeleton” of a comprehensive written PPE Program.

Laboratory Objectives

To successfully complete this laboratory exercise, the student will be able to:

1. **Describe** what is required in a PPE Program.
2. **Apply** the appropriate standards in OSHA for chemical protective clothing.
3. **Evaluate** a vendors list for applicability of PPE based on various types of vendor testing.
4. **Develop** a basic outline for a PPE Program for a hypothetical co.

Lesson Outline

1. Discuss elements of a PPE Program:

- Each plan must have its site survey to demonstrate compliance with appropriate regulations specific to the site
- Number of person-hours that workers wear various protective ensembles
- The accident/illness experience
- Levels of exposure;
- Adequacy of equipment selection
- Adequacy of operational guidelines and standard operating procedures

- Donning & doffing P.P.E.
- Adequacy of decontamination, cleaning, inspection, maintenance, and storage programs
- Adequacy and effectiveness of training and fitting programs
- Coordination with overall safety and health program elements
- The degree of fulfillment objectives, i.e., is our job task simply to respond or to train, or to actually perform tasks in the field
- Program records of training given
- Maintenance, fitting for each individual person
- A method for improving the program and modifying it
- The estimated costs of the program.

Laboratory Exercise

Students should be given a description of a company that is in the hazardous waste business. It will be a company just starting and they will therefore need to develop a PPE Program for their employees that will be expected to do site cleanup and sampling..

Based on the information covered so far, students working in small groups are to prepare a written skeleton for a PPE Program for this company. Part of their program will be the elements of medical monitoring and training required for each employee.

Suggestions for Development and Presentation

The exercise is started with a brief discussion of the paper provided by the instructor that describes a start-up company. The start-up company doesn't have much experience in hazardous materials management, but with new employees they want to start out right and therefore the opportunity exists for a discussion and demonstration of a good program.

Schedule and Assignments

This laboratory is suggested to take 3 hours of laboratory time.

The instructor should compile, for student reading, excerpts on the following topics from the references and resources listed below:

1. The necessary material identification and environmental surveillance elements.
2. Medical surveillance requirements.
3. Selection of equipment and how that is accomplished.

4. The training in and fitting of equipment.
5. How decontamination and cleaning is afforded.
6. What kind of program there is for inspection, maintenance and storage.
7. How the program is shown and used by the employees.
8. How is it used and evaluated.
9. How is it used in the field, how is it operational.

Lab reports should be turned in during the next lab session.

References and Resources

- NIOSH/OSHA/USCG/EPA, *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, Chapters 4, 5, and 8; on Training, Medical Programs, and PPE Programs
- Workers Compensation, Firemans Fund Representatives

Introduction to the Selection of Respiratory Protection

Intent and Purpose

This lesson will present an overview of respiratory protection and its importance in P.P.E.

In this lesson the student will learn the appropriate respiratory protection decision logic to be utilized when deciding when, what, and how to wear respiratory protection. The instructor shall discuss pathways of exposure and the importance of excretion and transportation of toxics into the body system. Protection of nose, mouth and lungs will be discussed from an anatomical viewpoint. A more detailed discussion of respiratory protection equipment should be presented. The equipment should be displayed from the simplest to the most complex type and how it operates, its function, its performance and the appropriate decision logic for use.

We will discuss the effect of each type of respiratory protection on the user through discussion of work type and duration, breakthrough times, protection factor, and maximum use limits.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Apply** the logic for respiratory protection selection.
2. **Describe** the uses and capabilities of each type of respiratory protection equipment.
3. **Select** by shape, size, use, and task, the appropriate respiratory protection.

4. **Know** how to clean and maintain this equipment.
5. **Explain** training methods for use of the equipment.
6. **Understand** what a face fit means.
7. **Describe** how to wear and use respiratory protection equipment from simplest to the most complex, i.e., canister, cartridge, half face, full face, SCBA, or Cascade system.
8. **Understand** the principles of pressure demand or negative pressure unit.
9. **Describe** OSHA required standards.
10. **Apply** the definition of protection factor and maximum use limit (MUL), as they relate to a specific piece of equipment and the contaminant to be protected from.

Lesson Outline

1. Historical use of personal protective equipment.
2. Discussion of the mechanics of particulate, fume, and organic vapor, adsorption or chemical reaction or physical removal for air purifying.
3. Discuss the mechanics of air purifying respirators:
 - Canister
 - Cartridge
 - Half Face, Full Face
 - Exhalation valves
 - Speaking diaphragms
 - Hoses
 - Types of Materials
 - Headbands
 - Donning and Doffing
 - Materials of Construction
 - Silicone vs. Rubber Face Piece
4. Discuss SCBA air supplying respirators:

- self contained breathing apparatus
- positive pressure, negative pressure
- cascade system
- OSHA standards for cascade systems
- how to fill a cascade bottle;
- how to fill a bottle from a cascade system;
- compressed system
- how it can be used, the standards, and requirements for OSHA
- form, function
- mechanics of use
- different types and manufacturers
- where exhalation valves are
- hose assembly
- different types of air canisters worn
- aluminum, steel, fiberglass wrapped
- high pressure vs low pressure
- hydrostatic testing

Suggestions for Development and Presentation

There are numerous audio visual aids in respiratory protection. Demonstration of real equipment in the classroom is an absolute necessity.

The subject matter benefits from a “walk through” of decision logic given a certain set of circumstances. A review of literature and books that illustrate various types of respirators should be part of the logic. Possibly engage a vendor to bring different elements of Cascade vs. air compressors so students can visually experience the mechanics of the unit. Display the different types of respiratory equipment from the most complex to the simplest.

Every kind of color combination from at least three different manufacturers offering cartridge or canister respirators should be available to the student and be demonstrated by the instructor. Logically deciding the correct respirator for a specific chemical will be a part of the classroom study.

References and Resources

All the books associated with NIOSH, OSHA, and EPA listed under references for this module are excellent references. The OSHA standards themselves are resources, as are the fire department, local health department, and local vendors.

Schedule and Assignments

This lesson is designed for 3 hours of class time. Follow Lesson Outline to provide excerpts from suggested resources for student study.

Field Monitoring

Intent and Purpose

The intent is to demonstrate the workings of typical instruments used for monitoring chemicals in the environment.

The approach is to describe the instruments in detail, then have the students individually use and interpret the instrument readings.

Laboratory Objectives

To successfully complete this laboratory exercise, the student will be able to:

1. **Identify** typical field monitoring instruments and their capabilities.
2. **Demonstrate** the workings of each instrument.
3. **Interpret** those readings in a decision making process.

Pre-Lab Outline

1. List the air monitoring instruments, Oxygen Meter, combustible gas indicator (CGI), and pH meter.
2. Describe the operating theories and principles for each.
3. Illustrate the interpretation and limitations of the data obtained.
4. Show the characteristics of instruments expected in the field.
5. Describe hazardous atmospheres, inherent safety, sensitivity, selectivity, portability.
6. Demonstrate Class I chemicals by groups.

7. Describe explosion proof versus intrinsically safe.
8. Understand what types of certification are approved for each instrument.
9. For each instrument describe the theory of operation, the limitations, and its usefulness in the field for the explosive atmospheres and oxygen deficient atmospheres.

Laboratory Exercise

The laboratory exercise consists of using the combustible gas meter and demonstrating the lower explosive limits of certain prepared gases and vapors such as gasoline, methane, ammonia, and to calibrate these instruments using the appropriate gas under pressure.

The exercise with the oxygen meter will be to demonstrate its use by blowing into a bag and measuring the oxygen left in the bag from exhaled air.

The laboratory exercise will also demonstrate the colorimetric indicators, using the Draeger Tube System, or equivalent, by specific chemicals such as ammonia, carbon monoxide and toluene.

The lab in pH will measure corrosivity in prepared liquids of water and acid, water and caustics, and prepared foods such as; cola, lemons, baking soda and water. Both pH paper and a pH meter are used.

Once the students are familiar with the theory and limitations of each of the instruments, the oxygen meter, the combustible gas indicator, the colorimetric tube indicator, pH paper and meter, stations will be set up with known quantities of gases and liquids, and the students must select an instrument and measure, using the appropriate instrument, each consideration, and then interpret that reading as to the safety of an employee.

Suggestions for Development and Presentation

Members of the local health department and local fire department, Haz Mat Unit, should have calibration gases that can be used safely in this operation. Safety is a critical factor, proper ventilation will be needed in the room. Enough instruments should be available for every two or three people to utilize an instrument.

The presentation of the lab is to develop information on a chart and then to compare the results of the chart with other students in the lab. This should demonstrate the limitations, not only of the instrument, but of the user.

References and Resources

The manuals accompanying each instrument, the oxygen level manual for the combustible gas indicator and the manuals for the colorimetric tubes and pH meters should be used.

Schedule and Assignments

This lab is designed to take 3 hours of class time.

After the instructor goes through the theory of operation of each instrument and its limitations students will go to the instrument and measure known volumes and concentrations of gases.

Handouts can be made for student study from vendors information on instruments and instrument instruction manuals.

Decision Logic for EPA Ensembles A, B, C, D

Intent and Purpose

The intent of this lesson is to, through the use of logic and rationale, determine the appropriate amount of personal protective equipment to be used for a specific task and to understand the full range of equipment use, function, and problems associated with same, including stress related illness.

The approach is the review the CPC and Respiratory Protection concepts in their entirety and use this to develop a fully integrated PPE decision logic.

Lesson Objectives

To successfully complete this lesson the student will be able to:

1. *Understand* how to protect themselves from safety and health hazards and to prevent injuries from incorrect use of equipment or malfunction of the PPE.
2. *Develop* a suitable logic for selection of PPE, including when to upgrade or downgrade, within a written PPE program.
3. *Understand* the EPA's logic for Level A, Level B, Level C and Level D and any modifications between them,

Lesson Outline

1. Discuss the following basic factors of concern in PPE selection:
 - Component Factors
 - Ensemble Factors
 - Environmental Factors
 - Human Factors
 - Mission Factors
2. Continue, in more detail, the previous discussion of permeation and degradation and hat transfer characteristics, and other special conditions on-site or per task.
3. Discuss reasons to upgrade, or reasons to downgrade the ensembles.
4. Levels of protection dealing with the amount of contamination, risk associated with that contamination due to its toxicity, flammability, reactivity, or corrosivity.
5. Function of the site safety officer on every project.

6. Heat transfer characteristics of each kind of PPE, durability, flexibility, ease of decontamination.
7. Requirements for maintenance and storage.
8. Selection of levels of protection dealing with the nature of the hazards and the heat stress consequences of each kind of personal protective equipment.
9. Air supply consumption, ambient temperature issues, in-use monitoring.
10. Heat stress and other physiological factors.

Suggestions for Development and Presentation

This lesson should provide an orderly discussion of the decision logic for personal protection equipment which include CPC and respiratory protection, from the simplest to the most complex. This would give information on simple exposure, due to simple tasks, such as, reconnaissance and surface sampling. The more complex emergency responses in uncontrolled situations such as incidents, accidents, emergencies, whereby more complex chemicals are involved are discussed. Work duration is another factor to include in a discussion from the simple to a more complex. Through the use of charts develop on the board a matrix and discussions of what kinds of risks each task poses to the user.

Presentation should include discussions of existing operation plans, job safety plans, medical monitoring requirements, policies, and standard operating procedures.

A discussion should also be included of the manufacturers and suppliers of personal protective gear, who they are and based on the location of the student, where he can obtain more technical information according to his or her work needs.

References and Resources

- EPA publications noted previously
- *NIOSH Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*
- OSHA and NIOSH Codes
- Local vendors or manufacturers
- Fire Departments
- Health Departments
- Suppliers can provide many catalogs that the students can use in discussion.
- *NIOSH Personal Protective Equipment for Hazardous Materials Incidents, A Selection Guide*, by U.S. Department of Health and Human Services.

Schedule and Assignments

This lesson is suggested to take 3 hours of class time. Students should be given pertinent handouts from the resource and reference sources listed.

Field Monitoring, Continued

Intent and Purpose

The intent is to demonstrate the working of other typical instruments used for monitoring chemicals in the environments that were not covered in the previous lab.

The approach is to describe the instruments in detail, then have the students individually use and interpret the instrument readings.

Laboratory Objectives

To successfully complete this laboratory exercise, the student will be able to:

1. *Identify* typical field monitoring instruments and their capabilities.
2. *Demonstrate* typical field workings of each instrument.
3. *Interpret* those readings in a decision making process.

Pre-Lab Outline

1. List the common air monitoring instruments such as, photoionization detector (PID), and flame ionization detector (FID), Foxborough's organic vapor analyzer and an infra-red spectrophotometer, the Miran infra-red spectrophotometer.
2. Describe the operating theories and principles.
3. Illustrate the interpretation and limitations of the data obtained.
4. Show the characteristics of instruments.
5. Describe hazardous atmospheres, inherent safety, sensitivity, selectivity, portability.
6. Demonstrate Class I chemicals by groups.
7. Describe explosion proof versus intrinsically safe.
8. Understand what types of certification are approved for each instrument.
9. For each instrument describe the theory of operation, the limitations, and its usefulness in the field for explosive atmospheres oxygen deficient atmospheres, and potentially toxic atmospheres.

Laboratory Exercise

The laboratory exercise consists of using the P.I.D., F.I.D., and Infra-red Spectrophotometer in certain prepared gases and vapors such as gasoline, methane, ammonia, and to calibrate these instruments using the appropriate gas under pressure.

The exercise for each meter will be to demonstrate its use by explaining its use and operation and measuring a chemical of unknown concentration.

Once the students are familiar with the theory and limitations of each of the instruments, the stations will be set up with known quantities of gases and the students must go and measure, using the appropriate instrument, each chemical, and then interpret that reading as to the safety of the employee.

Suggestions for Development and Presentation

Members of the local health department and local fire department, Haz Mat Unit, should have calibration gases that can be used safely in this operation. Safety is a critical factor, since ventilation will be needed in the room. Enough instruments should be available for every two or three people to utilize an instrument simultaneously.

The presentation of the lab is to develop information on a chart and then to compare the results of the chart with other students in the lab. This will demonstrate the limitations, not only of the instrument, but of the user.

References and Resources

The manuals accompanying each instrument.

Schedule and Assignments

This lab is expected to take 3 hours of classroom time.

Decontamination

Intent and Purpose

Decontamination is the process of removing or neutralizing contaminants that may have accumulated on personnel equipment or chemical protective clothing and is critical to the health and safety of employees.

The intent of this lesson is to show how to minimize the transfer of harmful materials into clean areas and preventing mixing of incompatible chemicals with protective clothing, respiratory equipment, tools, and vehicles used on-site. We can protect the community and personnel by preventing uncontrolled transportation of contaminants.

The approach will be to describe the types of contamination that workers may encounter at a waste site, note the factors that influence the extent of contamination and show the proper methods for preventing or reducing contamination.

Environmental Technology

The intent is to provide general guidelines while not being specific for designing and selecting procedures for decontamination.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Develop** general guidelines for designing a decontamination sequence appropriate for the types of contaminants, the volume of contaminants, and specific to the type or task to be completed.
2. **Present** a decision aid for evaluating the health and safety aspects of the selected decontamination methods.

Lesson Outline

1. Introduction as to why decontamination is necessary.
2. The requirements of a decontamination plan, determining stations, numbers of equipment needed, methods required, procedures to prevent contamination of clean areas, the need for revision of the plan and reassessment based on success of decontamination.
3. Prevention of contamination
4. Work practices, remote sampling and handling rather than worker involvement.
5. Protection of monitoring and sampling instruments. The use of disposable outer garments.
6. The covering and encasing of tools or the encasing the source of contaminants.
7. In addition, the use of standard operating procedure to maximize worker protection and the use of CPC in a health and safety plan.
8. Types of contamination that a person might encounter on a work site.
9. The five major factors that effect the extent of permeation, contact time, concentration, temperature, size of contaminant molecules versus C.P.C. pore space and physical state of waste.
10. Decontamination methods; physical removal and chemical removal.
11. The testing for effectiveness of decontamination, visual observation, wipe sampling, cleaning solution analysis, and testing for permeation.
12. Health and safety hazards associated with decontamination. While decontamination is performed to protect health and safety it can pose hazards under certain circumstances.
13. This outline shall include the incompatibility with hazardous substances, incompatibility with clothing, or pose a direct health hazard to workers.

14. Decontamination facility design will include a brief discussion of the contamination reduction zone and the exclusion zone based on the amount, location and exposure based on workers duties, functions and activities at the exclusion zone or any other zone associated with the facility.

15. Decontamination equipment selection. A list of typical decontaminations grouped by

- chemicals
- low chain hydrocarbons
- salts
- organic compounds
- inorganic compounds
- acidic versus basic compounds
- non-polar compounds versus water soluble compounds
- selected solvent to be used in decontamination such as detergents, soaps, water, dilute acids
- straight chain molecules, such as hexane, fuel oil
- common petroleum products such as fuel oil

16. Decontamination equipment selection will include a discussion of personnel decontamination versus small equipment and heavy equipment decontamination.

17. Disposal methods for equipment used in decontamination must be included.

18. Emergency decontamination is included to assist the student in the decision logic in emergencies.

Suggestions for Development and Presentation

Review of any OSHA laws that require decontamination.

A discussion of the different types of chemicals that might be associated with contamination.

Present a rationale appropriate for a small task, small amount of contamination versus a large task with great contamination.

The compatibility of equipment and chemicals for decontamination of personnel and equipment is discussed for both small and large decon needs.

References and Resources

NIOSH books on DECON

Emergency Response Teams from local government

Schedule and Assignments

Chapter 10 in the NIOSH *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* book presents good information on decontamination.

Respiratory Equipment: Face Fit

Intent and Purpose

In this exercise, the student will properly fit an air-purifying half-face respirator, and be fit for one also by strictly following Federal OSHA regulations.

Laboratory Objectives

To successfully complete this laboratory exercise, the student will be able to:

1. **Choose** the correct fit of respirator.
2. **Describe** all the parts of a respirator.
3. **Properly** self-adjust for correct fit.
4. **Do** a simple negative and positive pressure fit test.
5. **Perform** an OSHA approved face fit using isoamyl acetate or irritating smoke.
6. **Know** the basic elements of a Respiratory Protection Plan.

Pre-Lab Outline

1. Students should have been given information on Qualitative Fit Test Procedures from CFR 29, 1910.1025, Appendix D **prior** to this lab. At the time of the lab, the instructor should review and/or demonstrate these procedures to make sure they are fully understood by the students.
2. Review the parts of a respirator and demonstrate the proper donning and doffing of respirators.
3. Discuss appropriate elements of a Respiratory Protection Plan.

Laboratory Exercise

1. Students should work in groups of 6-7 people.

2. Each group should make up their standards for the odor threshold test and set up necessary equipment in accordance with the standards in CFR 29.
3. If there is not enough equipment for all groups to be setting up simultaneously, the instructor can assign half the class to work on elements of a Respiratory Protection Plan and then switch half way through class. A Respiratory Protection Plan is to be written by each group.
4. Each group will fit test all of their members making sure each person gets the opportunity to completely oversee and conduct and entire test.

Suggestions for Development and Presentation

Request local vendors to supply at least 5 respirators from three different manufacturers in all sizes, if possible.

A 55 gallon drum liner makes a good chamber. The chamber should be in a vented place as the isoamyl acetate (banana oil) is detectable at low concentrations.

References and Resources

CFR 29, 1910.1025, Appendix D.

NIOSH Documents and Publications Previously mentioned.

Schedule and Assignments

This lab is expected to take 3 hours of classroom time.

Site Control and Containment

Intent and Purpose

The intent of this lesson is to familiarize the participants with concepts and methods for containing, controlling and treating releases of hazardous substances from accidents or an uncontrolled hazardous waste site. Emphasis is on practical application of the theories needed to evaluate incidents and determine the best and most acceptable methods for controlling the release.

The approach used will be to address the most simplified events that could take place and the tasks associated with those events and move to more involved and greater volume emergencies that could take place for the different kinds of chemicals for different groups of chemicals in various quantities and physical states such as, gas, liquid, or solid releases.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. *Describe* the initial methods and procedures for containing and treating hazardous substance releases on-site.
2. *List* available information systems for determining the most appropriate method of the containment.
3. *Evaluate* the environmental considerations and trade-offs for different control measures.
5. *Explain* the reporting requirements under local and Federal laws.

Lesson Outline

1. Requirements of various laws, CERCLA, OSHA, Title 22, and California Health and Safety Code.
2. Reporting requirements for various laws.
3. Describe the various types of equipment and the nomenclature used in spill control and containment to include the various types and demonstration of leak equipment by using vendor catalogs and vendor examples.
4. Initial actions, hazard recognition and material identification. The implementation and notification in the contingency plan, spill area isolation and entry control.
5. The selection of personal protective equipment and field monitoring equipment.
6. Initial mitigation techniques, vapor suppression, sorbent application, insitu treatments, solids vacuuming, tarping.
7. Leak stoppage, overpacking, patching, plugging, packers. Special considerations for large vessels, large containers, products under pressure, both liquid, solid and gas.
8. Leak containment, diversions, ditches, pits, sumps, dikes, dams, booms.
9. Product retrieval, skimming, pumping, bulking and content transfers, soil excavation and solids clean-up.
10. Ancillary actions, chemical accident first aid, initial reporting of the spills, requirements for transporting, storing and placarding materials. Various sources of information and assistance in the initial phase of spill control and containment are described.

Suggestions for Development and Presentation

This lesson is developed first by understanding the requirements of the various laws that require an immediate response to a spill, release, or leakage, depending on the volume, the commodity and its physical state, liquid, solid, or gas.

Students should have an understanding of the laws and their application, understand how emergency contingency plans for a plant or the operation are carried out during the initial phases of an emergency response and spill containment. Again, this lesson will review the various techniques of control in a simple release, up through a complex release of both a liquid, a solid and a gas and then with various degrees of volumes associated with each one. It is important that the planning aspects be covered, but not in great detail. Module III will cover all the planning aspects of emergency response.

In addition, the presentation should include examples of booms, vapor suppression, absorbents and patching equipment. Limitations of these pieces of equipment should be noted.

References and Resources

- Local emergency response teams comprised of environmental health departments, fire departments, special districts on the county and city level.
- The emergency response team E.R.T., for the Environmental Protection Agency (EPA) at either the San Francisco or Long Beach offices.
- Various state contractors that respond to emergencies on highway or off highway under state contract. These are available on a yearly basis from Department of Health Services.
- Local emergency response advisory committees, SARA Title III.
- References should include the “National Spill Control and Countermeasure Act,” & appropriate OSHA laws.
- References include the *Handbook For Oil Spill Clean-up Procedures*
- EPA document *Methods To Treat Control and Monitor Spilled Hazardous Materials*
- References from the National Conference on Control of Hazardous Materials Spills.
- Also basic references are referred to as the Oil and Hazardous Materials Technical Assistance Data System, also known as OHMTADS, access through EPA Regional Offices.
- CHRIS, Chemical Hazard Response Information System, developed by the Coast Guard, Volume 1, *Condensed Guide To Chemical Hazards*, Volume 2, *Hazardous Substance Data Manual*, Volume 3, *Hazard Assessment Handbook*, Volume 4, *Response Methods Handbook*.

Schedule and Assignments

This Lesson is expected to take 3 hours of class time. Appropriate handouts should be developed by the instructor to cover the material listed.

Donning and Doffing Personal Protective Equipment

Intent and Purpose

The purpose of this Lab will be to increase the knowledge level of the student by building on information gathered in Lab 4, a simplified selection logic for personal protective equipment.

The intent and approach is to develop a more complex scenario utilizing more than one group of chemicals at a higher level of theoretical exposure and develop a logic by the student as he selects personal protective equipment for a more complex task for a longer period of time. Proper donning and doffing will be emphasized.

Students will be presented a scenario developed by the instructor that is more complex than that of Lab 4, so students realize donning and doffing can be more difficult to do.

Laboratory Objectives

To successfully complete this laboratory exercise, the student will be able to:

1. **Select** appropriate PPE for more complex scenarios that would demonstrate their knowledge of PPE decision logic.
2. **Demonstrate** proper “donning” and “doffing” of PPE.

Pre-Lab Outline

NIOSH *Personal Protective Equipment...* Book, Pages 188, 189, and 190 as described before.

Laboratory Exercise

The exercise is both written and hands-on. Selected students from the group will be made to don the appropriate gear to protect themselves as they perform complicated tasks over a longer period of time in an environment of both liquid and gas that are described in a scenario written by the instructor. This scenario is a paper that is developed by the instructor that describes the scene of an accident within the plant that the employees must respond to and complete certain elements of their contingency plan, which might be to control the spill and leak, or the shut valves that might be releasing dangerous gases into the air. This scene should incorporate more than one group of chemicals and utilize more than one physical state, i.e., liquid, solid, or gas. With the papers reviewed by the student, they will select, in groups, the appropriate equipment to don and will defend their logic according to the tasks required to complete the contingency plan. The only physical activities will be the hands-on donning of the equipment necessary to complete the task; doffing the P.P.E. shall incorporate decon operations also.

Suggestions for Development and Presentation

Students should break up into no more than three or four to a group. All equipment should be laid out from Level A, B, C and D. At this exercise, medical monitoring is required of the student who is donning the personal protective equipment, and the potential students who will be donning and doffing within the group shall have a authorization and a release from a physician stating that their heart, circulatory and respiratory system is capable of participating in strenuous activities.

References and Resources

- NIOSH *Personal Protective Equipment...* Book, Pages 188, 189, 190
- EPA Manual, *Response Safety Decision Making Workshop*, Parts 1, 2, 3, 4, and 5
- Vendors in the area of personal protective equipment to demonstrate and utilize this equipment at a savings to the college.

Schedule and Assignments

This laboratory exercise is expected to take 3 hours of class time.

All gear must be laid out and available for the students in quantities dependent on as many groups as will be utilizing said equipment.

Complex Site Control and Containment

Intent and Purpose

The intent of this lesson is to familiarize the participants with concepts and methods for containing, controlling and treating more complex releases of hazardous substances from accidents. Emphasis is on practical application of theories needed to evaluate incidents and determine the best methods for mitigating them.

The approach used will be to build on the skills and knowledge gained in previous labs to address more complex incidents with greater volumes in emergencies that could take place for different groups of chemicals in various quantities and physical states.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Describe** the methods and procedures for containing hazardous substances on-site.
2. **Evaluate** the environmental considerations and trade-offs in different control measures.
3. **Explain** the reporting requirements under local and Federal laws.

Lesson Outline

1. Requirements of various laws, CERCLA, OSHA, Title 22, and California Health and Safety Code.
2. Reporting requirements.
3. Describe equipment needed for spill control and methods to contain chemicals for larger volume spills.
4. Initial actions, hazard recognition and material identification. The implementation and notification in the contingency plan, spill area isolation and entry control for a more complex incident involving multiple chemicals.

Environmental Technology

5. The selection of personal protective equipment and field monitoring equipment for unknowns and mixed chemicals.
6. Initial mitigation techniques, vapor suppression, sorbent application;
7. Leak containment, diversions, ditches, pits, sumps, dikes, dams, booms.
8. Product retrieval, skimming, pumping, bulking and content transfers, soil excavation and solids clean-up.
9. Various sources of information and assistance in the initial phase of spill control and containment.

Suggestions for Development and Presentation

The development of the lesson is best described as understanding the laws and their application, understanding the emergency contingency plan for the plant or the operation, carrying out the initial phases of an emergency response and containment. Again, reviewing the various techniques of control in a simple release, up through a complex release of both a liquid, a solid and a gas and then with various degrees of volumes associated with each one.

The presentation should include releases into areas that threaten the environment, the public or ground water and should include waterways, streams, other bodies of water and the techniques needed to control them into the soil and into the air.

References and Resources

References should include the “National Spill Control and Countermeasure Act” and *Handbook For Oil Spill Clean-up Procedures*

References from the “National Conference on Control of Hazardous Materials Spills.”

Also basic references are referred to as the Oil and Hazardous Materials Technical Assistance Data System, also known as OHMTADS, access through EPA Regional Offices.

Schedule and Assignments

This lesson is expected to take 3 hours of class time.

This Lesson shall develop an understanding of more complex responses to control spills that actually threaten the public or waterways due to complex chemicals on large volumes.

Examples of spill control equipment should be available for class viewing. Handouts should be made from pertinent sections of resources and references listed.

Calculations of \dot{V}_{O_2} /Air and Heat Stress

Intent and Purpose

Once a suitable ensemble of PPE - respirator, chemical protective clothing, and ancillary equipment - has been selected, factors which affect mission duration must be carefully considered. Of great concern is the interaction of human and environmental factors which influence the buildup of heat within the PPE/wearer microenvironment, and which affect the rate of air/oxygen consumption as well. The intent of this Lab is to calculate cooling capacity and air supply based on factors specific to the site.

Several important factors must be considered in calculating: 1) the cooling capacity required to maintain suit temperature at a level which will reduce the risk of heat injury to the worker, and 2) the amount of air/oxygen supply necessary for completion of the projected task. These calculations are essential in the determination of whether:

1. Cooling is necessary;
2. The available cooling capacity is sufficient to accomplish the intended mission;
3. The available air/oxygen supply is sufficient to accomplish the intended mission;
4. The mission duration/work regimen must be adjusted to maintain the safety of the worker.

A procedure for the step-by-step calculation of necessary cooling capacity and air/oxygen supply follows. The procedure utilizes worksheets and look-up tables to guide the student in selecting the proper components and in modifying the mission should cooling requirements and air/oxygen requirements exceed that available. The look-up tables follow the worksheets provided in this section.

Laboratory Objectives

To successfully complete this laboratory exercise, the student will be able to:

1. **Calculate** the estimated amount of time a wearer can use the various protective ensembles based on laboratory and field information.
2. **Calculate** cooling capacities and air supply given factors already calculated in tables.
3. **Demonstrate** how to compensate for these limitations.

Pre-Lab Outline

The following should be discussed:

1. The metabolic heat and how it is calculated
2. Environmental heat
3. Required coolant supply

4. Coolant duration
5. Mission duration without cooling
6. Air consumption rate
7. Open circuit SCBA or SAR duration
8. Required air supply
9. Mission duration limited by air supply
10. Oxygen consumption rate
11. Mission duration limited by oxygen supply
12. Required oxygen supply
13. Employee fitness maximum or peak work rate
14. The sustained work rate or duty factor

The calculation, descriptions, and definitions just given are the beginning of the lab.

Laboratory Exercise

Worksheets:

W1, W2, W3, W4, W5, W6, W7, W8, W9, W10, W11, W12, W13, W14, W15.

To be distributed and explained to the students. These are worksheets on the different rates and the resultant calculation.

In addition to the Worksheets there will be tables:

T301, T302, T303, T304, T305, T306, T307, T308, T309, T310, T311, T312.

These Tables are given to the students to complete the calculations required on the Worksheets, so each worksheet will be developed by the student with the available Tables at his/her disposal and use. In this way the student can determine the approximate oxygen/air supply and the required cooling capacity given certain specifics of the worksites and task.

Suggestions for Development and Presentation

Metabolic Heat:

The amount of metabolic heat produced by a worker is dependent upon the workrate of the individual, the duration of the work, and modifications to his workrate and heat retention due to the protective ensemble.

Using Table III-1 you can look up the approximate rate of metabolic heat produced for various tasks.

Modifications to the workrates given in Table III-1, which are for a 154-pound person in light street clothes, can be made for:

- slope (Table III-2)
- terrain (Table III-2)
- body weight (Table III-3)
- ensemble weight (Table III-4)
- ensemble encumbrance (Table III-5)
- heat efficiency (Table III-9) and,
- heat loading (Table III-10).

The product of these factors and the workrate is the metabolic heat stress rate. The amount of heat produced in Kcals is simply the rate x task duration or

$\text{kcal/min} \times \text{min} = \text{kcal}$; where the times (in minutes) cancel out.

When more than a single task is required and the workrates differ, you can calculate the amount of heat generated by each task and add these amounts up.

$(\text{kcal/min} \times \text{min}) + (\text{kcal/min} \times \text{min}) + (\text{kcal} \times \text{min}) = \text{kcal}$
(first task) (next task) (last task) (total of all)

Or, you can estimate the composite workrate. The most conservative approach would be to take the maximum workrate and use that for your calculations.

References and Resources

Worksheets - W1 through W15 and Tables T301 through T312 are provided.

Schedule and Assignments

Each student is provided all worksheets and tables in prepared booklets. Exercises are demonstrated by instructor; students then demonstrate knowledge by calculating information provided in a scenario given by the instructor.

Handling Drums and Other Containers

Intent and Purpose

Accidents may occur during the handling of drums and other containers of hazardous waste or hazardous materials. While these hazards are always present, proper work practices such as minimizing handling, and using equipment with procedures that isolate workers from hazardous conditions, will minimize the risk to the worker. The approach for this lesson should focus on the review of equipment methods, and procedures drum handlers and hazardous waste workers have used successfully.

Environmental Technology

A description of the smallest containers or vessels such as vials and laboratory equipment containers are discussed along with the five gallon, thirty gallon, fifty-five gallon drums and the D.O.T. regulations that mandate their construction. Vessel handling equipment such as grapplers, slings, forklifts and trucks are discussed.

Included in the familiarization of the student with the containers are tanks, vaults, vacuum truck containers, elevated tanks, compressed gas cylinders and ponds and lagoons, as they are containers possibly for hazardous waste.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Define** the practices and procedures for safe handling of drums and other containers.
2. **Explain** proper drum movement, equipment, and drum sampling procedures.
3. **Describe** the types of drums and containers.
4. **Recognize** drum deterioration and its attendant hazards.
5. **Establish** drum maintenance procedures.
6. **List** types of materials stored in various containers.

Lesson Outline

This lesson shall briefly review the various laws that regulate drum storage and drum maintenance, as they are found in OSHA, EPA, and DOT regulations. This review should be brief as students get this information in other classes in the EHMT curriculum.

More emphasis should be placed in identifying the various types of containers, the particular hazards involved with various containers, and typical hazardous substances stored in each type of container.

Basic handling procedures should be discussed with drum grapplers, forklifts, cranes, slings. Opening the drums, sampling the contents, bulking and staging drums, segregating drums, noting when a drum is deteriorated or damaged, is discussed.

A discussion of special problems with vacuum trucks, tanks and vaults and compressed gas cylinders, or ponds and lagoons is included.

Suggestions for Development and Presentation

This lesson should present typical tasks associated with each type of vessel or container or drum, such as, noting what is on a drum, how it should be labeled, how to recognize a DOT drum, how to recognize common drums or vessels, how to recognize deterioration or damage in a drum, how to recognize the different kinds of drums associated with each type of hazardous material and how to sample or move each type of container safely.

The most effective method of presentation would be to associate a task with each type of vessel.

References and Resources

- Drum recyclers in the area.
- The Department of Health Services, Field Offices
- Any contractors or bulkers associated with bulk shipments such as, Oil companies, Chemical companies.
- Local health and fire departments

Schedule and Assignments

This lesson is expected to take 3 hours of class time.

Handouts should be developed for the students that cover pertinent topics in this lesson.

Field Exercise

Intent and Purpose

The intent of this exercise is to demonstrate the use and selection of monitoring equipment and PPE. Students will use knowledge gained in this module to effect the objective or to complete a task that deals with hazardous materials or work conducted on a hazardous waste site.

The elements previously learned that will be utilized in this exercise include: developing a mission plan, a health and safety plan, a monitoring plan, equipment donning and doffing, equipment selection, decontamination, and cleanup of the property. Finally, back in the classroom, students will participate in a critique of individual and/or group actions.

The approach will be to provide a scenario of a site and actually have barrels of liquids or solids for the students to sample, survey, and contain in the initial phases of a response. This laboratory exercise will also reinforce the importance of planning that will be covered in more depth in Module III.

Laboratory Objectives

To successfully complete this laboratory exercise, the student will be able to:

1. **Demonstrate** through a field exercise, the skills to properly use PPE, monitoring equipment, and containment procedures to complete a mission.
2. **Recognize** the necessity for pre-planning.
3. **Understand** the limits of equipment and personnel.

Pre-Lab Outline

Environmental Technology

1. Briefly review what constitutes an operations (or mission) plan, a site safety plan, a sampling plan, and a monitoring plan. Students received information on these plans in Module I.
2. Students should have been provided a brief outline of the scene and the history of the site that they will be doing their field exercise in. This site should have barrels of simple materials that require them to take samples of liquids from a barrel and samples of soils from either a barrel or ground.

Barrels or vials or containers should have various commodities such as ammonia or toluene, or petroleum products, so that they can use the various monitoring instruments such as the HNu, Colorimetric tubes, flame ionization detector, pH paper, etc., as appropriate in a survey mode. Spillage of liquid near a drum should require control, as needed.

Laboratory Exercise

1. Students should be allowed to work amongst themselves to assign specific tasks to members of the class in the organizational approach to the objectives.
2. Each student should be responsible for developing some element of the various plans required. After any individual work is completed the students should meet for no more than an hour to develop the overall plan
3. The second hour students should actually perform the task. This includes the actual selection process and donning of personal protective equipment and the use of all necessary monitoring equipment. The exercise should continue until the completion of the task.
4. The third hour should be devoted to follow-up activities such as cleaning up, replenishing equipment, and offering a critique of the activities.

Suggestions for Development and Presentation

It may be advantageous to have students work on individual activities **prior** to class in the interest of time. With the minimal time allowed, it is also important for the instructor to have done all the “scene staging” prior to the start of class. All equipment and supplies should also be readily available to the students.

It is best if the instructor does not interfere much, if at all, in the progress of the exercise. This will provide a more realistic atmosphere and will allow students a better learning experience as well as a more lively critique!

The sample scenario/fact sheet in the attachments for this lab can be used or the instructor can make up another. Included should be similar information as that on the sample (purposely sketchy).

Much of the equipment may have to be rented from vendors, or provided by the vendors. It may also be possible to get local fire or health officials to help with the exercise, including some equipment, under the CAER (Community Awareness and Emergency Response) programs.

References and Resources

- NIOSH, *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, U.S. Govt. Printing Office

- Local Fire Departments
- Local contractors who do this as state licensed hazardous waste contractors
- Emergency Response personnel from EPA Regional Offices or local health departments.

Schedule and Assignments

This lab is expected to take 3 hours of class time. Since it is the final lab of this module, there are no further assignments.

Field Exercise

BACKGROUND

Your company has just purchased a small site from a company that had gone through bankruptcy in the early 1980's; old barrels and equipment have been located on the property. This company had a lot of prior research with oil field chemicals and bulk hazardous materials.

KNOWN

There have been odor complaints from nearby businesses and barrels have been "popping."

Barrels and containers were noted.

Heavy machinery and pumps in the area.

Light wind intermittent with dust devils.

OBJECTIVE

Your company needs an initial review of the materials at the new company, noting obvious hazards, identifying any chemicals, and samples taken. Based on this information, a further plan for site characterization and clean-up will be done.

Use available instruments to investigate and take samples:

- 1) Drum thief of liquid in largest volume, one sample;
- 2) Use ammonia draeger for the other drum
- 3) Spill control for liquid spilled from drum

METHODS USED

Mission Development:

- 1) Operations Plan
- 2) Sampling Plan
- 3) Equipment Required
 - Air Monitoring Instruments
 - PPE
 - Sampling Equipment
 - Decon
 - Spill Containment from Leaking Drum
- 4) Medical Monitoring
- 5) Health and Safety Plan
- 6) Critique of Operations

Decision Making in Emergencies

Instructor's Guide

Prepared By:

Ann Boyce
Bakersfield College
1801 Panorama Drive
Bakersfield, CA 93305
(805) 395-4552

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Preface

This is the instructor's guide for a module entitled *Decision Making in Emergencies*.

This module is part of *Safety and Emergency Response*, a 4 unit lecture/laboratory core course in the EHMT Associate Degree and Certificate Program. The course is designed to provide students with hands-on instruction in the *applications* of safe hazardous materials handling and response to emergencies.

The course has been divided into three modules:

- **Module I Hazardous Materials Awareness and Safety**
- **Module II Spill Control and Emergency Response**
- **Module III Decision Making in Emergencies**

This modularization has been designed in such a way that the course can be taught as three separate "mini-courses." Modules II and III are each 45 hours and therefore represent 1.5 lecture/lab units. Module I is 24 hours so can be taught as a 1 unit course.

Modularization will allow the maximum flexibility for individual colleges to meet both traditional educational goals **and** the immediate needs of local industry. This flexibility is evidenced by the following available options, since the modules can be used in whole or part for:

- **Contract Education**
- **Community Service Classes**
- **Degree and Certificate Applicability**

The lab exercises have also been designed with this flexibility in mind. Each lesson plan is for one week, or three hours, of lecture time. Associated with each lesson is a three hour lab exercise. Lab exercises can be taught either in separate lab periods **or** can be alternated with lecture topics in an integrated course approach.

Decision Making in Emergencies

Module Description

This module is comprised of 45 lecture/laboratory hours covering the following aspects of safety and emergency response to hazardous materials spills and incidents:

- Use of “Events Analysis”
- Decision Making Processes
- Use of Hazardous Materials Behavior Models
- How to Develop Contingency Plans
- Performing Incident Hazard Evaluation
- Managing Emergency Operations
- Planning for Incident Mitigation and Treatment
- Use of the Incident Command System
- Use of Tabletop Exercises
- Field Exercise

Specific objectives are listed for each of the 7 lessons and 7 laboratory exercises described in this module.

Texts

Suggested Student Texts:

California Office of Emergency Services, *Hazardous Material Incident Contingency Plan*, 1990.

Instructor Resources and References are described within this document.

Instructor Note

Note to Instructors: It is suggested that the instructor using this module read through **all** lessons and labs prior to starting the course. In this way, later concepts which are built on earlier activities can be better anticipated and planned for.

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Decision Making in Hazardous Materials Operations

Intent and Purpose

This lesson will introduce the student to understanding hazardous material behavior. It will stress the importance of defining a problem *before* attempting to mitigate it. The analytical method that is used to help with this “problem definition” is called “Events Analysis.” The student will get the opportunity to apply and practice these methods in subsequent labs.

The D.E.C.I.D.E. Process is covered to show a method that helps to guide decision making at hazardous materials emergencies. It is designed to help minimize confusion, guesswork, mistakes, delays, unnecessary harm, and loss of control.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Give** three reasons why it is important to “define your hazardous material problem” before getting directly involved in an incident.
2. **Explain and List** Benner’s D.E.C.I.D.E. process.
3. **Define** events analysis.

Lesson Outline

1. Introduce the module and the grading and attendance requirements. A “Skills Survey” can be conducted by putting together questions from this module. This will ascertain student knowledge prior to instruction and will give them an idea of the expectations for this part of the course.
2. Describe some past hazardous materials incidents to give the student a historical perspective and to reinforce the need for proper response.
3. Explain process of analyzing a situation in order to better understand the problem:
 - Realization that a problem exists
 - Defining the problem
 - Identifying likely harm associated with that problem

4. Go over a decision making process such as D.E.C.I.D.E.:

D— Detect hazardous materials presence (this step was covered in Module I of this course)

- Occupancy and location
- Container shapes
- Markings and colors
- Placards and labels
- Shipping papers and other documents
- Your senses

E— Estimate likely harm without intervention

- A difficult but indispensable step

- Visualization techniques

C— Choose your response objectives

- Goals of response activities

I— Identify your action options

- Consideration of all practical options
- Availability of personnel and equipment to do job

D— Do the best option

- Choose option offering the potential of greatest gain with least loss

E— Evaluate your progress

- Continually evaluate progress to insure goals are being met
- Re-evaluate problem if desired results are not being achieved

5.Begin a more in depth discussion of “Estimating Likely Harm Without Intervention.”

- Most likely the most critical step in the D.E.C.I.D.E. Process and often the least understood
- Two main steps involved:
 - Visualizing or predicting what is likely to happen if nothing at all is done, and then:
 - Describing the likely outcome based on the predicted event behavior.
- “Events Analysis” is a tool in that it breaks down complex actions into smaller, more easily understood parts or events. The following must be described in order to use events analysis:
 - Who or what is involved;
 - What is happening now with the people or things involved;
 - What is likely to happen next as the incident progresses

Suggestions for Development and Presentation

The first step of the D.E.C.I.D.E. was covered in the first Module of this course. Students were then given the opportunity to look at slides and make decisions based on the six clues to determine whether hazardous materials were likely present. Because of this, this step should be covered quickly.

The majority of the class time should be spent on “estimating likely harm without intervention.” This will prepare the student for the following laboratory. When discussing this in class, it would be very beneficial to use slides from the FEMA course entitled *Recognizing and Identifying Hazardous Materials*. Use of these slides will help the students practice events analysis. For instance, a slide depicting some aspect of a hazardous materials emergency could be shown. The instructor could ask what is likely to happen in this situation. This will allow students to discuss and verbalize their thoughts. They can then be lead through the proper break down of events into less complex parts.

References and Resources

Environmental Technology

- HMTRI, *Course HMT 210* has a list of past hazardous materials incidents that can be used to lecture from (Introduction)
- HMTRI, *Course HMT 240*, Lesson 1

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Handouts should be made from the material in this lesson plan and the resources listed for student use.

Events Analysis

Intent and Purpose

This laboratory exercise is designed to allow the student to apply the information received in the preceding lesson. Small groups of students will conduct an “Events Analysis” for a given situation.

Laboratory Objectives

To successfully complete this laboratory exercise, the student will be able to:

1. **Conduct** a comprehensive events analysis given information about an emergency situation.
2. **Describe** likely outcomes of an emergency with and without intervention.

Pre-Lab Outline

Explain the exercise and review any areas that were not adequately covered in the previous lesson.

Laboratory Exercise

The instructor needs to use a slide that depicts a scenario matching the situation described on the “Events Analysis Exercise” sheet under “What Has Already Happened.” The slide needs to depict a derailment with a tank containing a flammable compressed gas. Other tanks need to be shown exposed to a fire created by the release of product from one tank. If the instructor does not have access to a slide depicting a matching scenario, the Event Analysis Exercise sheet needs to be changed to reflect the scenario used.

1. Small student groups should use the information provided as well as visual information (slides) provided by instructor to complete the Events Analysis Exercise sheet attached (or a similar one developed by instructor).
2. Each group will turn in one sheet for evaluation by the end of the laboratory period. Time should be set aside to discuss results.

Suggestion for Development and Presentation

Be sure to allow 30-45 minutes at the end of the laboratory period to discuss results. A completed Events Analysis Worksheet is provided for the scenario described.

References and Resources

- FEMA, *Recognizing and Identifying Hazardous Materials*, a course with slides that provide several good options for this exercise.

Schedule and Assignments

This laboratory is suggested to take 3 hours of classroom time.

Student groups must turn in their assignment prior to the class discussion at the end of this session.

Hazardous Materials Behavior Model

Intent and Purpose

Principles of hazardous material behavior are not well understood. It is important to address the combination of hazardous material and container behavior. This lesson describes the factors that affect the behavior of hazardous materials in an emergency. Determining the interrelationship among these factors can help considerably in visualizing what is likely to happen in an emergency.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Describe** the “hazardous materials behavior model.”
2. **List** and be able to recognize the types of stress, breach, release, dispersion, and hazardous material travel patterns.
3. **Differentiate** between impingement and harm, and identify factors which influence the range of harm.
4. **Identify** four factors which affect behavior of hazardous materials in emergencies.

Lesson Outline

1. Discuss the four factors which affect the behavior of hazardous materials in an emergency:
 - Inherent properties and quantity of the hazardous material
 - Built-in characteristics of the container
 - Natural laws of physics and chemistry
 - Environment, including the physical surroundings (terrain) and the conditions (weather).
2. Introduce the following events and consider through class discussion how they interrelate in an hazardous materials emergency:

Breach

- Under normal conditions, hazardous materials are controlled by some kind of container (tanks, pipes, cylinders, bottles, bags, etc.)
- For an emergency to begin, the container must be disturbed or stressed in some way.

Breach

- If the container is stressed beyond its recoverable limits (design strength or ability to hold the contents), the container opens up.

Release

- When the container breaches, the contents can escape. Contents escape in the form of matter or energy, or a combination of both.

Engulf

Environmental Technology

- Escaping matter and/or energy travel away (disperse) from the point of release, forming predictable patterns governed by natural laws of physics and chemistry.

Impinge

- As the hazardous material and/or container travel away from the release point, it (they) may touch or impinge upon vulnerable exposures such as people, systems (including the environment), and property.

Harm

- The impinged exposures may be harmed depending on the dosage or concentration of the material impingement.
- Therefore, if this is what happens in an emergency, we can use this sequence of events to help us predict specifically what is likely to happen in an emergency.

3. Cover the questions that should be answered in predicting the likely outcome in an emergency:

- *Where* is the hazardous material or container likely to go when released in an emergency?
- *Why* is the hazardous material or container likely to go there?
- *How* will the hazardous material or container get there?
- *When* will the hazardous material or container get there?
- *What* harm will occur when the hazardous material or container gets there?

4. Introduce the Hazardous Materials Behavior Model:

- First look for stressed containers in any emergency
 - Stress is applied force or system of forces that tend to strain or deform a container and/or trigger a change in condition of the contents.
 - Stress can affect both/either the contents and/or the container

There are five basic forms of stress:

- *Thermal* (Fire, sparks, friction, electricity, ambient temperature changes such as extreme cold)
- *Mechanical* (Object physically contacting the container with effects such as punctures, gouges, bending, breaks, tears, etc.)
- *Chemical* (For example, acids corroding container, pressure generated by decomposition or polymerization)
- *Irradiation* (Alpha, beta, and gamma radiation)
- *Etiologic*

- Know how the container will breach

There are five basic types of breach:

- *Disintegration* (A total loss of integrity such as a glass jar shattering)

- *Runaway Cracking* (Rapidly growing crack where the container breaks apart into three to five pieces, e.g. BLEVE)
- *Attachments Open Up* (For example, pressure relief device functioning)
- *Puncture* (For example, coupler puncture, drum puncture)
- *Split or Tear* (For example, torn bags or boxed, split plastic drums)

- Look for energy or matter to escape

There are four types of Hazardous Material Releases:

- *Detonation* (Associated with explosive chemical reaction in less than 1/100th of a second)
- *Violent Rupture* (Associated with runaway cracking and/or closed containers, e.g. BLEVE; Time is less than a second)
- *Rapid Relief* (Release through pressure relief devices, damaged valves, punctures, or broken piping over several seconds to several minutes)
- *Spill or Leak* (Nonviolent flow through openings in fittings, splits or tears, and punctures taking minutes to days)

- Predict your dispersion patterns

- *Matter*
- *Energy*

When the contents of a container are released, they are free to travel and disperse. When the contents travel, the problem is more likely to escalate. Where the hazardous material goes at this time is dependent on the product characteristics, various chemical laws, and the environment.

- What form is it in? (Infra-red or gamma rays, pressure waves, dusts, fragments, organisms, liquids, vapors, vaporizing liquids, etc.)
- What is making it move? (Thermal differential, self-propelled, wind, personnel transport, gravity, diffusion, etc.)
- What path will it follow? (Linear, radial, random, upward, etc.)
- What dispersion pattern will it create? (Cloud, stream, irregular deposits, etc.)

- Determine Impinge and Harm Events

- As the contents travel from point of release, they impinge or touch on, or contact exposures (people, systems, property)
- Impingement may be short, medium, or long term

Three factors which affect or determine harm include:

- *Timing of release*
- *Size of area covered*
- *Lethality* (dosage or concentration received)

Suggestions for Development and Presentation

Environmental Technology

Since the material for this lesson is not in the text, it is important for the instructor to make handouts from the outline material contained in this lesson plan as well as the resources listed. The material will make more sense to the student during the following lab session where they will apply these principles.

References and Resources

- Benner, Ludwig, *Hazardous Materials Emergencies*, Events Analysis, Inc., 1978.
- HMTRI, *Course HMT 240*, Lesson 1
- Washington State Department of Community Development, Fire Protection Services Division, *Hazardous Materials Operations*

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments are as follows:

- Handouts compiled by instructor

2. Hazardous Materials Behavior Model

Intent and Purpose

In this laboratory, students will have the opportunity to apply and use the information on predicting hazardous materials behavior that was covered in the previous lesson.

Students will systematically work through worksheets that cover all aspects of the model.

Laboratory Objectives

To successfully complete this laboratory exercise, the student will be able to:

1. **Apply** the elements of the Hazardous Materials Behavior Model given information about an emergency situation.
2. **Evaluate** the likely harm given information about a hazardous material emergency.

Pre-Lab Outline

The instructor should cover any points that needed further elaboration from the previous lesson.

Laboratory Exercise

Prior to conducting these exercises, the instructor should determine which of the cases from the attached “Hazardous Materials Case Histories” should be used. Selection should be based upon relevancy to local problems and concerns. The cases should be identified as newspaper accounts that will not be complete. Suggestions for cases are given for each exercise.

1. Stress Breach Building Exercise

- A. Have students get into small groups and pass out the Stress/Breach Skill-Building Exercise. Indicate which case studies are to be used and start the exercise. Ask students to try to visualize each of the incidents as they read them. Suggested cases: 31, 33, 46.
- B. When students are finished, lead a class discussion of their answers.

2. Release/Engulf Skill Building Exercise

- A. Pass out worksheet to small groups of students. Indicate case studies to be used. Suggested cases: 4, 15, 39.
- B. When students are finished, lead a class discussion of their answers.

3. Impinge Exercise

- A. Pass out worksheet to small groups of students. Indicate case studies to be used. Suggested cases: 6, 32, 45.
- B. When students are finished, lead a class discussion of their answers.

4. Use of General Behavior Model

- A. Use an available slide and scenario information such as meteorological information, people involved, material involved, etc. to provide practice on use of the General Behavior Model. Pass out General Behavior Model Worksheet to small groups of students. In evaluating the situation, students are to place a circle around the expected event category and use arrows to provide sequence. In part 2 they are to evaluate outcomes with and without intervention.
- B. When students are finished, lead a class discussion of their answers.

Suggestions for Development and Presentation

Be sure to thoroughly discuss each worksheet as it is completed by the groups. This will clarify any areas that are difficult for the students. If this is done, the final worksheet can be used for evaluation purposes.

References and Resources

The references and resources are the same as those listed for Lesson 2.

Schedule and Assignments

This laboratory is suggested to take 3 hours of classroom time.

Students are to complete all assignments during the laboratory session.

3. Contingency Plans

Intent and Purpose

While major spills are rare, spills in general are not, and in some areas there are daily occurrences in which tanks, drums, bags, bottles, pails, boxes, puddles, streams, piles, and clouds of materials of varying degrees of hazard are encountered dispersed in a manner that no one ever intended.

This lesson introduces the student to the use of contingency planning for emergencies. Specifically, the student will learn how to evaluate whether a contingency (preparedness) plan is needed to deal with spills and how to prepare a plan, properly selecting what should be in it.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. *Explain* the importance of planning for hazardous materials emergencies.

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2. **Describe** how state, local, and federal agencies interact and coordinate their response efforts.
3. **Compare and contrast** the various types of emergency plans.
4. **List and define** some basic required steps in the planning process.

Lesson Outline

1. Discuss the reasons for planning:
 - Individuals who may become involved in an environmental emergency should be prepared to act in the most appropriate manner. This takes *advance* planning. Plans make the difference between rational action and haphazard reactions.
 - Importance of coordination with local and state agencies.
 - Legal requirements such as the Clean Water Act, National Contingency Plan, and California Health and Safety Code, Chapter 6.95.
2. Describe the approaches to planning:
 - Plans which are narrow in scope versus more comprehensive planning.
 - Ability/necessity to coordinate with various governmental agencies.
 - Availability of planning aids and incentives (state/federal assistance programs)
3. Compare the types of plans:
 - Telephone rosters (simplest)
 - Action Guides and Checklists (one/two page, easily carried)
 - Resource/Equipment Lists (can be assembled into overall community or other regional lists)
 - Response Plans (tells how to handle an emergency spill situation)
 - Coordination Plans (aimed at defining the responsibilities of various agencies, groups, or individuals under various emergency response conditions.
 - AD HOC Plans (pros and cons of informality)
4. Review the importance of incorporating Hazard Analysis into the plan. Hazard Analysis was covered in the first lessons and labs. Planning starts with knowing what the problem is!
5. Briefly describe the emergency responsibilities of the various state, federal, and local agencies:
 - Interagency Organizations (CEPRC, HWSF, RRT, SIOSC)
 - State Government (ARB, Coastal Commission, DOG, CCC, etc.)
 - Local Government (Law Enforcement, Environmental Health, Fire, etc.)
 - Federal Government (DOT, EPA, FEMA, NSF, etc.)
 - Non-Governmental Agencies (Businesses, CAER, Poison Control Centers, etc.)
6. Cover the basic steps of the planning process:
 - Hazards Analysis
 - Review of prior plans (if available)
 - Identifying functions of Emergency Response of Support Groups (part of Response Planning)
 - Identifying comprehensive emergency responsibilities (part of Coordination Planning)
 - Identify deficiencies
 - Plan appraisal and continuing planning

It is important not to get too bogged down in details when covering the material in the lesson outline. The student will have the opportunity to apply the concepts in the form of developing an actual contingency plan in a subsequent lab exercise.

It may be useful when describing the various types of plans to use familiar analogies from everyday life. The attachments for this lesson include several pages from the FEMA planning guide (described as an instructor resource below) that provide understandable comparisons to use.

It is also important to stress that planning is only one step in the process of coping with spills. It defines what should be done, but does not assure that it will be done. Anyone that makes a plan to have in a company's files in case it is needed is wasting valuable time. A plan is only functional if it is *applied* and someone is responsible to see to it that it is updated as new hazards are identified, equipment/personnel are available and properly maintained, exercises are conducted, etc.

Do not spend too much time on the agency responsibilities. These are described very adequately in the OES publication described as a main text for this module.

References and Resources

- FEMA, *Planning Guide and Checklist for Hazardous Materials Contingency Plans*, 1981.
- HMTRI, *Course HMT 210, Hazardous Materials Emergency Response I*, Lesson 2.

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments are as follows:

- Textbook (OES publication), Chapters 1 and 2
- Handouts developed from FEMA document described as a reference for this lesson and HMTRI *Course HMT 210*.

3. Incident Hazard Evaluation

Intent and Purpose

Any incident involving hazardous materials must be thoroughly evaluated. First, the materials present must be identified. Then further evaluation can proceed. The physical and chemical properties of the materials are a major factor in evaluating how they affect public health and the environment.

This laboratory session will review the identification and evaluation of properties of chemicals in order that the student possess a firm foundation in the basics of Hazard Analysis. This information will be built-upon in subsequent lessons and labs.

Lesson Objectives

Environmental Technology

To successfully complete this laboratory exercise, the student will be able to:

1. **Compile** the chemical and physical properties associated with the chemicals presented in the exercise.
2. **Determine** the hazards inherent to working with chemical substances.
3. **Identify** the chemical and physical properties that support treatment decision-making.
4. **Evaluate** the chance (risk) that a given hazard will be present under three sets of ambient weather conditions.

Pre-Lab Outline

The instructor should ascertain what areas, in terms of understanding chemical characteristics, would be appropriate to review prior to giving the students this exercise. This is a good reason to evaluate their knowledge using a “Skills Survey” at the start of this module. Any areas of deficiency should be thoroughly reviewed, as otherwise this exercise may be a bit overwhelming.

Laboratory Exercise

A. Hazard Recognition

1. Students should complete Parts I and II of three separate Hazardous Substance Data Sheets using the attached sources of information on toluene, sodium hydroxide, and acetaldehyde.
 2. After compiling information on the Data Sheets, determine the safety hazard for each compound, and the properties that indicate likely containment and treatment techniques.
 3. Evaluate the change in degree of hazard for each material based on meteorological conditions.
- B. In the event of a spill of any of these materials, identify the characteristics of each substance that will have an impact upon site safety planning and the choice of containment and treatment alternatives. Use attached Chart #1 for this purpose.
- C. Evaluate the following situations. List the potential hazards of each substance for each of the three ambient conditions. Assume the substances are outside in open containers. Also list any physical/chemical properties of importance.
1. Temperature 90 degrees Fahrenheit; clear skies
 2. Temperature 60 degrees Fahrenheit; raining
 3. Temperature 20 degrees Fahrenheit; clear skies

Use attached Chart #2 for this purpose.

Suggestions for Development and Presentation

Students should work on this exercise independently. The instructor should be available to answer any questions that may arise.

References and Resources

There are no additional references for this exercise.

Schedule and Assignments

This laboratory is suggested to take 3 hours of classroom time.

Students should turn in their lab reports at the next lab session. The lab should then be reviewed and discussed by the class.

4. Managing Emergency Operations

Intent and Purpose

Effective management of emergency operations during the release or threatened release of a hazardous material requires that everyone involved know what their responsibility is. This lesson covers some of the basics of the Incident Command System (ICS), the accepted method for multi-agency response efforts.

The Governor's Emergency Operations Executive Council has directed state agencies to use this system. It is also required by Fed-OSHA under 29 CFR 1910.120 requirements. It has been "highly recommended" for use by other entities. For this reason, it is important that the EHMT student be able to utilize the system.

This is the first of three lessons dealing with various aspects of managing emergency operations.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Explain** what the ICS is.
2. **Define** "Unified Command" and explain where it is used.
3. **List and define** the 5 major functional areas of the ICS.
4. **Describe** the role of the "Responsible Party" in the ICS.
5. **Explain** the circumstances under which evacuations may be indicated.
6. **Identify** terms commonly used in the ICS.

Lesson Outline

1. Explain what the ICS is and why it is necessary.
2. Describe the importance of the following components of the ICS:
 - Common Terminology
 - Modular Organization
 - Integrated Communications
 - Unified Command Structure

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- Consolidated Action Plans
- Manageable Span-of-Control
- Predesignated Incident Facilities
- Comprehensive Resource Management

3. Cover the 5 major functional areas of the ICS:

- Command
- Operations
- Logistics
- Planning
- Finance

4. Review ICS Terminology:

Agency Representative— Individual assigned to an incident from an assisting or cooperating agency who has been delegated full authority to make decisions on all matters affecting that agency's participation at the incident. Agency Representatives report to the Incident Liaison Officer.

Allocated Resources— Resources dispatched to an incident that have not yet checked-in with the Incident Communications Center.

Assigned Resources— Resources checked-in and assigned work tasks on an incident.

Assisting Agency— An agency directly contributing suppression, rescue, support, or service resources to another agency.

Available Resources— Resources assigned to an incident and available for an assignment.

Base— That location at which the primary logistics functions are coordinated and administered.

Branch— That organizational level having functional/geographic responsibility for major segments of incident operations. The Branch level is organizationally between Section and Division/Group.

Camp— A geographical site, within the general incident area, separate from the base, equipped and staffed to provide food, water, and sanitary services to incident personnel.

Clear Text— The use of plain English in radio communications transmissions. No ten codes, or agency specific codes are used when using Clear Text.

Command— The act of directing, ordering and/or controlling resources by virtue of explicit legal, agency, or delegated authority.

Command Staff— The Command Staff consists of the Information Officer, Safety Officer, and Liaison Officer, who report directly to the Incident Commander.

Company— Any piece of equipment having a full complement of personnel.

Communications Unit— A vehicle (trailer or mobile van) used to provide the major part of an incident Communications Center.

Coordination— The process of systematically analyzing a situation, developing relevant information, and

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informing appropriate *command* authority (for its decision) of viable alternatives for selection of the most effective combination of available resources to meet specific objectives.

Cooperating Agency— An agency supplying assistance other than direct suppression, rescue, support, or service functions to the incident control effort.

Dispatch— The implementation of a *command* decision to move a resource or resources from one place to another.

General Staff— The group of incident management personnel comprised of: The Incident Commander, The Operations Chief, The Planning Chief, The Logistics Chief, The Finance Chief.

Incident Commander— The individual responsible for the management of all incident operations.

Incident Command Post (ICP)— The location at which the primary command functions are executed and usually collocated with the incident base.

Incident Command System (ICS)— The combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure with responsibility for the management of assigned resources to effectively accomplish stated objectives pertaining to an incident.

Mobilization Center— An off incident location at which emergency service personnel and equipment are temporarily located pending assignment, release, or reassignment.

Operational Period— The period of time scheduled for execution of a given set of operation actions as specified in the Incident Action Plan.

Planning Meeting— A meeting, held as needed throughout the duration of an incident, to select specific strategies and tactics for incident control operations and for service and support planning.

Resources— all personnel and major items of equipment available, or potentially available, for assignment to incident tasks on which status is maintained.

Staging Area— That location where incident personnel and equipment are assigned on a three (3) minute available status.

Task Force— A group of resources with common communications and a leader temporarily assemble for a specific mission.

Technical Specialists— Personnel with special skills who are activated only when needed. Technical Specialists may be needed in the areas of fire behavior, water resources, environmental concerns, resource use and training areas.

5. Discuss the responsibilities of positions within the Command function.

Suggestions for Development and Presentation

Environmental Technology

There is a large amount of information to cover in this lesson. For this reason, it is important to give the student a good foundation in concepts and terminology. Incident management will be covered in more detail in the following two lessons. Anything not satisfactorily covered in this lesson can be finished up in the next. Subsequent laboratory exercises will give the student an opportunity to apply their knowledge of the ICS.

Be sure to use the examples given in the student text (OES publication) for class discussion.

References and Resources

- Textbook (OES publication) Chapter 3
- NIIMS, *Incident Command System*, Fire Protection Publications, Oklahoma State University, Stillwater, OK 74078

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments are as follows:

- Textbook (OES publication) Chapter 3

4. Planning for Incident Mitigation and Treatment

Intent and Purpose

In this laboratory exercise, students will analyze a scenario to develop an appropriate plan of action for control and clean-up. Various computations must be performed to arrive at the necessary determinations to solve the problem.

Laboratory Objectives

To successfully complete this laboratory exercise, the student will be able to:

1. **Develop** an appropriate control and clean-up plan for a given situation.
2. **Solve** problems pertaining to volumes and percentages of spilled materials given basic information and conversion factors.

Pre-Lab Outline

1. Review the previous laboratory exercise.
2. The instructor should review any skills that the class may be less than proficient in that are necessary to complete this exercise.

Laboratory Exercise

Using the information on the scenario provided as an attachment to this laboratory, students working individually should:

1. Develop a control and clean-up plan for this situation.
2. Solve the following problems:
 - A. Determine the volume (gallons) of water in the farm pond.
 - B. Determine the volume (gallons) of spilled material on the surface of the pond.
 - C. Determine the percentage of the spilled material collected on the surface of the pond.

- D. Determine the amount of PCP, in grams, in the pond water.
What, if any, assumptions must you make to solve this problem?
- E. Under laboratory conditions it has been determined that one brand of activated carbon has an adsorption capacity of 49 mg PCP/gm carbon. How much of this carbon is required to remove all the PCP in the water? Is this answer realistic? Why or why not?

Conversion Factors

- 1.06 quarts/liter
- 1 gallon = 0.137 cubic feet
- 2.2 pounds/kilogram

Suggestions for Development and Presentation

Be sure to adequately review the previous laboratory exercise to help the students with their confidence in understanding chemical principles. The computations required in this exercise may intimidate some students so be sure to be available to help out if they get stuck. They should have had a basic chemistry class but these skills may be a bit “rusty.”

References and Resources

There are no additional references and resources for this exercise.

Schedule and Assignments

This laboratory exercise is suggested to take 3 hours of class time.

Students should turn in their completed assignments at the next laboratory session. Results should be discussed.

Managing Emergency Operation—Second Part

Intent and Purpose

This lesson continues to cover the use of ICS in hazardous materials emergencies. Specifically, it covers the Operations and Logistics functions in depth.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. *Explain* what the “Operations” function involves.
2. *Define* the hazardous materials control zones.
3. *Identify* the required training for the various Hazardous Materials Responder Levels found in 29 CFR, 1910.120.
4. *Explain* what the “Logistics” function involves.
5. *Describe* the importance of mutual aid.
6. *List* potential communications problems in an emergency.

Lesson Outline

1. Explain the concept of the “Operations” function.
2. Describe the importance of site control:
 - Exclusion Zone
 - Contamination Reduction Zone
 - Support Zone
3. Cover the 5 levels of training identified in 29 CFR 1910.120:
 - First Responder Awareness Level
 - First Responder Operations Level
 - Hazardous Materials Technician
 - Hazardous Materials Specialist
 - On Scene Incident Commander
4. Review how PPE levels are used in the ICS:
 - Level A
 - Level B
 - Level C
 - Level D
5. Discuss the proper use of the DOT Emergency Response Guidebook as well as other common resources.
6. Explain the concept of the “Logistics” function.
7. Discuss the advantages of mutual aid.
8. Describe potential problems with communications at an multi-agency response.

Suggestions for Development and Presentation

Some of the examples from Chapter 3 in the OES text can be expanded to use as case studies for discussion of the Operations and Logistics functions. Discussion of case studies will help the student to better understand the concepts presented.

The text does not give sufficient information on Fed-OSHA training requirements under 29 CFR, 1910.120. The instructor should acquire a copy of these regulations and provide appropriate information and excerpts to the students.

References and Resources

- Text, OES publication, Chapters 4 and 5, Appendix 1
- NIIMS, *Incident Command System*, Fire Protection Publications, Oklahoma State University
- 29 CFR, 1910.120 and 1910.121 (Excerpts on training requirements)

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments are as follows:

- Textbook (OES publication) Chapters 4 and 5, Appendix 1

5. Contingency Plans

Intent and Purpose

In this lab, students will utilize information learned in previous lessons and labs to develop contingency plans. Students will be provided with helpful checklists and industrial scenarios from which to develop their plans. Students will work in small groups to complete the exercise.

Laboratory Objectives

To successfully complete this laboratory exercise, the student will be able to:

1. **Develop** a hazardous materials emergency response plan for a hypothetical company.
2. **Identify** support systems and resources (both internal and external) available for a hypothetical company in their community.

Pre-Lab Outline

Be sure to review previous laboratory exercise. For this exercise:

- Discuss internal and external resources available to a local facility (“capability assessment”).
- Review a sample outline of a Hazardous Materials Emergency Response Plan such as that described in Lesson 2 of HMTRI, *Course HMT 210*.
- Explain the importance of management backing as demonstrated in a Policy Statement to preface the plan.

Laboratory Exercise

Students should work on this exercise in small groups. The instructor should develop one or more descriptions of fixed facilities that need Emergency Response Plans. Utilizing a sample outline and other checklists and information provided in this module, student groups should develop a *comprehensive* Emergency Contingency Plan for the facility.

Suggestions for Development and Presentation

The instructor should see to it that each group is efficiently utilizing their lab time by dividing the work and coordinating their efforts. After all, this is the type of cooperation that is necessary to effectively develop and implement these types of plans in the “real world.”

The facility descriptions given to the students do not have to be highly detailed. Allow the students to creatively “fill in the gaps.”

References and Resources

- HMTRI, *Course HMT 210, Hazardous Materials Response I, Lesson 2.*
- FEMA, *Planning Guide and Checklist for Hazardous Materials Contingency Plans.*

Schedule and Assignments

This laboratory is suggested to take 3 hours of classroom time.

Students should be given some time during the next lab session to finalize their plans. The completed plans should be turned in the lab session *after* next.

6. Managing Emergency Operations—Third Part

Intent and Purpose

This lesson continues to cover the use of ICS in hazardous materials emergencies. Specifically, it covers the Planning and Finance functions in depth.

Lesson Objectives

To successfully complete this lesson, the student will be able to:

1. **Explain** what the “Planning” function involves.
2. **Compare** the ICS Planning function with other planning requirements.
3. **Explain** how the California Hazardous Material Incident Reporting System (CHMIRS) works.
4. **Explain** what is required under SARA Title III Reporting.
5. **Describe** what the “Finance” function involves.
6. **List** potential sources of funding for emergency response activities.

Lesson Outline

1. Explain the concept of the “Planning” function.
2. Describe the importance of understanding other plan requirements:
 - Business Plans
 - Spill Prevention Containment and Countermeasures Plan (SPCC)
 - Risk Management and Prevention Programs (RMPP)
 - Hazardous Waste Facilities Emergency Plans
 - SARA Title III and CEPRC Area and Regional Plans
 - California Hazardous Material Incident Contingency Plan
 - California Oil Spill Contingency Plan
 - California Hazardous Waste Management Plan
3. Cover reporting requirements under the California Hazardous Material Incident Reporting System (CHMIRS).
4. Cover reporting requirements under SARA Title III.

5. Explain the concept of the “Finance” function.
6. Discuss the availability of funds for response activities.

Suggestions for Development and Presentation

Some of the examples from Chapter 3 in the OES text can be expanded to use as case studies for discussion of the Planning and Finance functions. Discussion of case studies will help the student to better understand the concepts presented.

The text does not give sufficient information on other planning and reporting requirements. The instructor is encouraged to put together supplemental information for the students in this area. Although some of these requirements are covered in other courses, applying them properly requires a comprehensive review.

References and Resources

- Text, OES publication, Chapters 6 and 7
- NIIMS, *Incident Command System*, Fire Protection Publications, Oklahoma State University
- Appropriate excerpts from state and federal laws pertaining to planning and reporting

Schedule and Assignments

This lesson is suggested to take 3 hours of classroom instruction.

Student reading/study assignments are as follows:

- Textbook (OES publication) Chapters 6 and 7

Tabletop Exercise**Intent and Purpose**

This laboratory will familiarize students with the use of tabletop exercises. The purposes of emergency exercises range from training to acquainting participants with their roles and responsibilities to a rigorous test of contingency plans and response capabilities.

In a tabletop exercise, participants are asked to respond orally to problems by discussing actions that they might take, and/or verbally “walk through” a process. This is excellent preparation for the final field “hands on” exercise.

Laboratory Objectives

To successfully complete this laboratory exercise, the student will be able to:

1. *Determine* actions that should be taken given an emergency scenario.
2. *Evaluate* the exercise in a group post-exercise critique.

Pre-Lab Outline

Environmental Technology

Time may need to be set aside in this lab session for groups to meet and finalize previous lab.

In this lab, the instructor should stress the importance of “dry runs” in both planning for and performing emergency response activities. The goals of the exercise should be explained as well as the time constraints (in order to make it more realistic).

The class should be divided into small groups where responsibilities are delineated and everyone gets an opportunity to participate.

Laboratory Exercise

Two sample tabletop scenarios are attached for use in this exercise. The instructor can develop others, if desired. Students should determine roles within their groups and use the ICS to “talk through” the emergency. All activities, actions, and developments should be recorded as the response progresses.

Suggestions for Development and Presentation

Probably the most important aspect of this exercise is the critique afterwards. Draw out the “lessons learned” in working through this exercise.

References and Resources

- U.S.E.P.A., *Guide to Exercises in Chemical Emergency Preparedness Programs*, May, 1988.

Schedule and Assignments

This laboratory is suggested to take 3 hours of classroom time.

Flexible Lesson

Intent and Purpose

The content of this lesson is left up to the discretion of the instructor. Suggestions are given, but the instructor may utilize this time to cover any special topics of special interest to the community where the course is being offered.

Lesson Objectives

To be determined by instructor.

Suggestions for Development and Presentation

This lesson provides an opportunity to fill in any gaps that have surfaced during the presentation of this course. It may also be beneficial to review spill containment and control procedures and use of reference and resource materials in preparation for the field exercise. Time can also be used for necessary pre-planning for the field exercise.

Field Exercise

This final laboratory exercise is a “hands on” field exercise that will require students to apply all the knowledge and skills gained in this course.

Intent and Purpose

To successfully complete this laboratory exercise, the student will be able to:

1. **Plan** an appropriate emergency response given a field scenario.
2. **Execute** an appropriate emergency response given a field scenario.

Pre-Lab Outline

Environmental Technology

The instructor may make some initial comments *before* the exercise, but once it is underway should not offer any advice or comments. This will allow the students to really think on their feet.

Laboratory Exercise The field exercise should be designed by the instructor with the available time, space, and resources in mind. The exercise should be handled as realistically as possible. The exercise should be run “real time” wherever possible.

The last 30-45 minutes of the class should be reserved for a critique of all activities in this exercise.

Suggestions for Development and Presentation

It may be helpful to enlist the help of local fire or environmental health representatives to provide equipment and observation for further perspectives during the critique. They may also have a recent spill episode that can be made into a manageable scenario for this exercise. Since this is “hands on”, it is important that drums or other containers be used in staging.

There are no additional references and resources for this exercise.

This laboratory is suggested to take 3 hours of classroom time.

CHAPTER 3

RECOMMENDATIONS AND CONCLUSION

Technological innovation and legislative mandates ensure that the rapid changes currently being experienced in Environmental Technology will continue well into the foreseeable future, so it is critical that education in this field remains current. It is equally important that course content be standardized so that all graduates can be realistically expected to possess similar levels of knowledge when they enter the workplace. To support those objectives, the Environmental Technology/HazMat Subcommittee of the 1994 - 1996 Public Safety Curriculum and Professional Development Project makes the following recommendations:

- immediately update the remaining four curriculum outlines that were last reviewed in 1990
- establish a rotational pattern on a three-year cycle that will ensure the regular updating of all classes
- promote the standardization of Environmental Technology classes by developing standardized tests to be used in all classes that are designed to cover required competencies
- continually add to those tests to provide an extensive bank of potential test questions
- continue using e-mail and other forms of electronic communication as a medium for ongoing curriculum discussions
- explore the possibility of establishing an accreditation process through the Partnership for Environmental Technology Education (PETE), a national professional organization
- collaborate with high school Tech Prep programs to promote careers in Environmental Technology

Environmental Technology educators throughout California are pursuing these objectives through their active involvement in the Statewide Environmental Technology Advisory Committee and the Partnership for Environmental Technology Education. In addition, a representative sits on the Statewide Advisory Committee for Public Safety Education in order to contribute to the ongoing discussion regarding the challenge of best preparing students for Public Safety careers. The discipline has established a web site at <http://nvc.cc.ca.us/et> where announcements, links to related web sites, and jobs for students are posted. Environmental Technology educators have also established an e-mail system to enhance communication among themselves and are in the process of developing an encryption program that will enable them to collaboratively prepare tests on-line without risking the integrity of their work. The realization of the seven recommendations listed above would substantively add to their efforts to provide the recency, standardization, and relevancy that are crucial to preparing students for careers in Environmental Technology.

APPENDIX A

STEERING COMMITTEE MEMBERS

Environmental Technology

STEERING COMMITTEE MEMBERS

Project Staff

Hugh Foster, Golden West College - Project Director
Tonya Hilligoss, Sacramento City College - Project Consultant
Sue Oliviera, South Bay Regional Public Safety Training Consortium - Northern California Coordinator
Frank Patino, Rio Hondo College - Southern California Coordinator

Subcommittee Chairs

Correctional Science - Jan Hayes - Project Officer, Correctional Science Curriculum Project - Merced College
Environmental Technology/HazMat - Ann Boyce - HazMat representative to the Statewide Advisory Committee for Public Safety Education - Bakersfield College
Fire Technology - Bill Lane - Past-President, California Fire Technology Directors Association - Allan Hancock College (ret.)
Law Enforcement - Fred Allen - Dean of Instruction, Butte College/Project Coordinator, Statewide Advisory Committee for Public Safety Education

Members

Ron Allen - POST - Chief, Training Deliverance and Compliance
Chris Almeida - K-12 Tech Prep representative, California Department of Education
Armand Burrue - California Department of Corrections representative to the Statewide Advisory Committee for Public Safety Education - CDC, Human Resources Development Office
Art Cota - Division Chief, Training Division, California State Fire Marshal's Office
Paul Dempsey - California Youth Authority representative to the Statewide Advisory Committee for Public Safety Education - Director of Training, CYA
Marv Engquist - Past-President, CAAJE - Cerritos College
Tom Feierabend - Past-President, State Association of Fire Educators; President, California Fire Technology Directors Association - Mt. San Antonio College
Gretchen Fretter - Past-President, CADA - Los Medanos College
Max Futrell - Four-year college representative to the Statewide Advisory Committee for Public Safety Education - CSU Fresno
Richard Doshen - Representative, California Police Chiefs Association - Yuba City Police Department
Steve Hart - Deputy Director, California State Fire Marshal's Office
Ron Havner - Dean, Public Safety Training - Evergreen Valley College
Mary Jennings - Representative, California Professional Firefighters
Dick McGrath - Public Safety representative to the State Academic Senate - Cerritos College
Bill Ogden - Representative, California State Firefighters Association Education Committee - Rancho Santiago College (ret.)
Chuck Page - Deputy Director, Standards and Training for Corrections, Board of Corrections
Jim Pope - Representative, California State Sheriff's Association - Shasta County Sheriff's Department
Frank Scotti - Southern California representative to the Statewide Advisory Committee for Public Safety Education for the California Fire Technology Directors Association - Rancho Santiago College

APPENDIX B

**STATEWIDE ADVISORY COMMITTEE
FOR PUBLIC SAFETY EDUCATION MEMBERS**

Environmental Technology

STATEWIDE ADVISORY COMMITTEE FOR PUBLIC SAFETY EDUCATION

Project Coordinator: Fred Allen, Dean of Instruction, Area I, Butte College
Chancellor's Office Representative: Leo Ruelas, Specialist in Public Safety Education

Business/Industry Representatives

Ron Allen	Chief - Training, Delivery and Compliance	Commission on POST
Arthur Branstine	President	Westec Security, Inc.
Armand Burrue	Asst. Dep. Dir., Human Resources Devel.	California Dept. of Corrections
Paul Dempsey	Chief, Training Services Division	California Youth Authority
Steve Hart	Deputy Director	Office of the State Fire Marshal
Thomas McConnell	Director	Board of Corrections
Jim Pope	Sheriff	Shasta County Sheriff's Dept.
Oliver Thompson	Chief of Police	Inglewood Police Department
Ray Vittori	Fire Chief (ret.)	Emeryville Fire Department

Education Representatives

Ann Boyce	Assoc. Prof., Applied Sci. and Tech. Dept.	Bakersfield College
Representative: Environmental Technology/Hazardous Materials		
Kelly Chun	Dean, Public Safety Center	Sacramento City College
Max Futrell	Professor/Chair, Dept. of Criminology	CSU, Fresno
Representative: Four-year Colleges		
Ronald Havner	Dean, Public Safety Training	Evergreen Valley College
Jan Hayes	Professor, Science Division	Merced College
Stan Kephart	Director, Public Service Center	Butte Community College
Richard McGrath	Professor, Administration of Justice Dept.	Cerritos College
Representative: State Academic Senate		
Frank Patino	Division Dean, Dept. of Public Service	Rio Hondo College
Representative: California Academy Directors Association (CADA)		
Frank Scotti	Director, Fire Technology Department	Rancho Santiago College
Representative: Fire Technology Directors Association (for Southern California)		
James Smith	Professor, Administration of Justice Dept.	West Valley College
Representative: California Association of Administration of Justice Educators (CAAJE)		
John White	Coordinator/Fire Chief	Shasta College
Representative: Fire Technology Directors Association (for Northern California)		

APPENDIX C

**CURRICULUM QUALITY ASSURANCE/QUALITY CONTROL
SUBCOMMITTEE MEMBERS**

CURRICULUM QUALITY ASSURANCE/QUALITY CONTROL SUB/COMMITTEE

Chair: Ann Boyce, Bakersfield College

Craig Baker, Cosumnes River College
Richard Casagrande, RAM Environmental Engineering
Richard Della Valle, Napa Valley College
Steven Fink, West Los Angeles College
Howard Guyer, Fullerton College
Michael Malachowski, City College of San Francisco
Stephen Onstot, Burke, Williams & Sorenson
Muriel Zimmerman, Chaffey College
Ken Zion, El Camino Community College

We would also like to thank the following industry advisory committee members whose contributions to the indentification of competencies were instrumental in developing these courses:

James Charley, RayChem Corporation
George Graff, Consultant
Donna Gilmore Rhee, EnsecoCal Laboratory
Meier Schneider, Professional Engineer
Robert Weimer, Weimer Manufacturing Co., Inc.

Gender Equity and Special Populations Consultant - Mary Thorpe, Thorpe, Hendrix and Associates

APPENDIX D

GENDER EQUITY/SPECIAL POPULATIONS CURRICULUM COMMENTS

ADDITIONAL INFORMATION FROM THE GENDER EQUITY/SPECIAL POPULATIONS CONSULTANT

(Mary Thorpe of Thorpe, Hendrix and Associates, an Educational Consulting Firm)

Gender Issues in the Workplace:

Although gender barriers have been broken for women in public safety careers for two decades, evidence continues to surface to indicate that women often find a hostile working environment that undermines their effectiveness in those careers. Further, problems surrounding gender can diminish the job performance of an entire department when those problems are ignored. Unresolved gender strife in the workplace can be extremely costly in fiscal terms as well. Donna Giles, Human Resource Director for the City of Sacramento, admitted that the fear of litigation, based primarily on gender discrimination and harassment, stimulated the city to hire outside consultants to conduct training sessions to teach supervisors and employees how to handle disputes and misunderstandings constructively in the Sacramento City Fire Department. The cost of the program - \$100,000. Even at that price, it is a good investment if the program prevents one lawsuit. Sixty-four percent of the formal complaints filed against the Sacramento City Fire Department in the last four years involved sexual harassment.

This problem is also evident in other agencies. According to a November 17, 1994 article by Stephen Green in the Sacramento Bee, in the two years before the article was written the California Department of Corrections had the largest number of sexual harassment complaints resulting in the greatest amount of consequent cash awards of all the California state agencies. Settlements, mediation, and court awards totaled \$5.15 million dollars for the two year period. Reportedly, hundreds of thousands of additional dollars were spent on investigations and legal fees.

These two examples are not unique. Men and women continue to have trouble co-existing and communicating in firehouses, correctional facilities, and squad rooms throughout the state and nation. Such friction takes its toll, and suggests that providing future public safety employees with a "strong dose" of gender equity is more cost-effective than waiting until gender-related disputes undermine both individual morale and departmental work performance.

Public Safety and Gender Issues:

Sexual harassment, sexual exploitation, and sexual violence are not about sex, but about power. Public safety employees, particularly those working in law enforcement and corrections, are trained to assume positions of power and to employ their power for the public good. However, misuse of that power, to any degree, can undermine the public trust and, carried to extreme, can ruin lives and careers.

The uniform, a symbol of authority, changes the dynamics of any interaction. New officers may not be fully aware of how the addition of the uniform or other symbols of authority, change interpersonal communication. For example, a member of the opposite sex may feel free to reject an unwanted sexual advance in a social setting — with no uniform, no gun, and no badge. But when that same advance is made by a person in uniform, it may appear to be a demand for sexual favors. There is another side of the same coin. Public safety workers may find themselves the target of unwanted sexual advances from people who want to trade sexual favors for preferential or lenient treatment. Some individuals may be tempted to be more sexually aggressive than they were before they were trained and employed in a field that expects them to seize command. These are dynamics that potential public safety employees need to understand.

Further, an understanding of the gender issues inherent in domestic violence is important, particularly for law enforcement personnel.

APPENDIX E

ORDER FORM FOR
CURRICULUM MATERIALS

Environmental Technology

The Environmental Technology Program ORDER FORM

INDIVIDUAL INSTRUCTOR GUIDES	No. of Copies	Cost of Copy	Total
Introduction to Environmental Technology	_____	x\$25.00 _____	= _____
Hazardous Waste Generation, Reduction & Treatment	_____	x\$20.00 _____	= _____
Health Effects of Hazardous Materials	_____	x\$40.00 _____	= _____
¹ <i>Basics of Toxicology</i> ¹ <i>Basics of Industrial Hygiene</i>			
Hazardous Materials Management Applications	_____	x\$40.00 _____	= _____
¹ <i>Right-to-Know Law</i> ¹ <i>Transportation & Storage of Hazardous Materials</i>			
¹ <i>Air Quality Issues</i>			
Hazardous Waste Management Applications	_____	x\$40.00 _____	= _____
¹ <i>Hazardous Waste Generator Compliance</i>			
¹ <i>Sampling & Analysis</i> ¹ <i>RCRA & Superfund</i>			
Safety & Emergency Response	_____	x\$30.00 _____	= _____
¹ <i>Hazardous Materials Awareness & Safety</i>			
¹ <i>Spill Control & Emergencies</i> ¹ <i>Decision Making in Emergencies</i>			
TOPIC-SPECIFIC MODULES			
Hazardous Waste & Small Business Workshop	_____	x\$20.00 _____	= _____
Environmental Concerns on Real Estate Transfers	_____	x\$20.00 _____	= _____
Source Reduction and Mmt. Review Act of 1989 (SB14)	_____	x\$20.00 _____	= _____
Transportation of Hazardous Wastes	_____	x\$20.00 _____	= _____
8 Hour Hazwoper Refresher Training	_____	x\$20.00 _____	= _____
Site Assessment & Remediation	_____	x\$40.00 _____	= _____
¹ <i>Module/Site Assessment</i> ¹ <i>Module II Site Characterization</i>			
¹ <i>Module III Remediation Technologies</i>			
Complete Set of Individual Instructor Guides	_____	x\$175.00 _____	= _____
Complete Set of Topic-Specific Modules	_____	x\$130.00 _____	= _____
A/V Package for Site Assessment & Remediation	_____	x\$150.00 _____	= _____
¹ <i>Module II & III 35mm Slides (65)</i> ¹ <i>Module III 6 hour EPA Video</i>			
Subtotal of Instructor Guides & Topic-Specific Modules			_____
California Community Colleges 50% Discount (if applicable)			_____
Shipping & Handling Charges (\$2.00/module not to exceed \$12.00/set)			_____
Tax (if applicable)			_____
Order Total			\$ _____

[] Purchase Order Enclosed
[] Check Enclosed

Payment MUST accompany order
Make payable to North Orange County Community College
District (NOCCCD)

Name _____ Organization _____
Address _____ City _____ State _____ Zip _____

SEND ORDERS TO: **Anaheim Higher Education Center**
100 South Anaheim Blvd., Suite 125
Anaheim, CA 93805
Phone: (714) 563-0058

APPENDIX F

**COMPETENCIES REQUIRED FOR THE
ENVIRONMENTAL HAZARDOUS MATERIAL TECHNICIAN**

COMPETENCIES REQUIRED FOR THE ENVIRONMENTAL HAZARDOUS MATERIALS TECHNICIAN

BACKGROUND & PHILOSOPHY:

With the aid of input from local advisory committees and numerous conversations with a variety of hazardous materials professionals, the eight faculty members of the California Consortium, along with their industry advisors, have agreed on this outline of the competencies. We believe for a technician to be well trained it is necessary for them to possess the following competencies. For the sake of clarity, these competencies have been subdivided into five major skill areas:

- I. Understanding & Complying With Regulations
- II. Hazardous Materials Handling & Sampling
- III. Procedures & Plans for Regulatory Compliance
- IV. Hazardous Materials Incident Response
- V. Maintenance of Professional Competence

The competencies identified under each of these headings on the pages that follow are not intended to represent an exhaustive list, but rather represent a number of the “key” areas which the technician must master.

I. UNDERSTANDING AND COMPLYING WITH REGULATIONS

A. UNDERSTANDS THE RULEMAKING PROCESS (AWARENESS)

1. Coding and basic numbering
2. Organization
3. Bureaucratic hierarchy (Federal, State, or Local origins)
4. Historical perspective

B. DETERMINES REGULATORY IMPACT (KNOWLEDGE)

1. Identifies statutes and regulations
 - a. air, water, soil, employee and public health/safety
 - b. keeps current on requirements
2. Determines scope and application
 - a. reads and comprehends laws and regulations
 - b. understands liabilities and penalties
 - c. is aware of public sensitivities

C. IDENTIFIES REGULATORY SOURCES & REFERENCES (KNOWLEDGE)

1. Determines regulatory jurisdiction (Federal, State, or Local Agencies)
2. Makes proper contacts
 - a. agencies with regulatory authority
 - b. information support services (e.g. Chemtrec, Chlorine Institute)
3. Distinguishes between regulations and organizational policies

D. APPLIES LAWS AND REGULATIONS (APPLICATION)

1. assists in compliance methods and strategies
2. carries out applicable standards
3. updates files and maintains records
 - a. material safety data sheets

- b. manifests
- c. permits
- d. others
- 4. assists in obtaining permits
- 5. maintains database tracking

E. COMMUNICATES EFFECTIVELY (APPLICATION)

- 1. Writes technical reports
- 2. Provides input to supervisors regarding regulations and compliance
- 3. Communicates verbally with others within organization
- 4. Reads and follows complex instructions
- 5. Maintains records

II. HAZARDOUS MATERIALS HANDLING & SAMPLING

A. RECOGNIZES HAZARDOUS MATERIALS/WASTES (APPLICATION)

- 1. Assists in identification/classification of hazardous materials/wastes per regulations
- 2. Assists in inventories and audits hazardous materials and wastes
- 3. Identifies and communicates problems and solutions to supervisor (inputs)

B. HANDLES HAZARDOUS MATERIALS/WASTES (APPLICATION)

- 1. Assists regulatory compliance
- 2. Completes necessary forms & procedures
- 3. Assists in proper transportation, storage, handling, tracking and disposal
- 4. Assists in housekeeping & safety practices
- 5. Recommends proper handling & usage
- 6. Can identify appropriate safety equipment & location
- 7. Is aware of haz. mats./waste minimization, reduction, and treatment procedures and requirements

C. PERFORMS SAMPLING & MONITORING (APPLICATION)

- 1. Can identify equipment & instruments
- 2. Provides for proper care & use of equipment
 - a. calibration
 - b. maintenance
 - c. storage
- 3. Ensures quality assurance/quality control (QA/QC)
 - a. maintains sample integrity during sampling
 - b. provides appropriate labeling
 - c. maintains sample chain-of-custody
 - d. records field documentation
- 4. Follows plot plans for sampling
- 5. Collects samples
- 6. Provides appropriate sample collection methodology
- 7. Performs simple tests & sample preparations
- 8. Works cooperatively with laboratory services

D. COMMUNICATES EFFECTIVELY (APPLICATION)

- 1. Organizes data for reports
- 2. Assists in the preparation of reports

3. Communicates results (outputs)
4. Coordinates distribution of information to others

III. PROCEDURES & PLANS FOR REGULATORY COMPLIANCE

- A. UNDERSTANDS GENERIC INDUSTRIAL PROCESSES & WASTE STREAMS (KNOWLEDGE)
- B. FOLLOWS AND UNDERSTANDS SAFETY PROGRAMS & GUIDELINES (APPLICATION)
- C. ASSISTS IN DEVELOPMENT OF COMPLIANCE PLANS & PROGRAMS (APPLICATION)
- D. ASSISTS IN PERFORMING REGULATORY AUDITS (APPLICATION)
 1. Assists in corrective action
 2. Verifies follow-up activities
 3. Practices proper employee ethics (e.g. trade secrets)
 4. Understands liabilities, sensitivities, and public relations
 5. Participates in critique of audit process
 6. Assists with contract services
 7. Assists in evaluating vendor performance
- E. TRACKS REGULATORY COMPLIANCE (APPLICATION)
 1. Maintains forms, records & databases
 2. Procures current material safety data sheets
 3. Understands & utilizes information on MSDS's
 4. Assists in revision & update of plans

IV. HAZARDOUS MATERIALS INCIDENT RESPONSE

- A. UNDERSTANDS INCIDENT PLAN(S) (AWARENESS)
 1. Knows responsibilities within the plan
 2. Assists in implementation of response plan
 3. Understands the "incident command" process
 4. Coordinates with emergency response personnel
- B. PERFORMS INCIDENT RESPONSE (APPLICATION)
 1. Identifies proper emergency equipment
 2. Uses proper emergency equipment
 3. Assesses incident hazards
 4. Assists in maintaining employee health & safety
 5. Participates in clean-up process
 6. Assists in verifying completion of incident
- C. MAINTAINS REPORTING/RECORDS FOR COMPLIANCE (AWARENESS)
 1. Participates in incident critique
 2. Assists in regulatory reporting, as required
 3. Compiles records and data

V. MAINTAINANCE OF PROFESSIONAL COMPETENCE

- A. READS & UNDERSTANDS CURRENT PUBLICATIONS (DESIRABLE)
- B. ATTENDS CLASSES, SEMINARS, WORKSHOPS (DESIRABLE)
- C. PARTICIPATES IN PROFESSIONAL ASSOCIATIONS (DESIRABLE)
- D. ACQUIRES AND MAINTAINS CERTIFICATION (DESIRABLE)
- E. PARTICIPATES IN COMMUNITY RELATIONS ACTIVITIES (DESIRABLE)

APPENDIX G
CERTIFICATE AND ASSOCIATE DEGREE REQUIREMENTS

ENVIRONMENTAL TECHNOLOGY CERTIFICATE PROGRAM

Environmental Technology (**ET**) refers to the knowledge and skills that allows a person to work with hazardous materials in compliance with government regulations and at the same time protect human health and the environment.

The **ET Certificate** is designed to be a one- to two-year program that can either prepare students or upgrade working individuals with technician-level skills.

Satisfactory completion of the following courses are required for the **Certificate**.

Semester Units

Environmental Biology	3
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Human Biology*	3
* or equivalent	

Allied Health Chemistry*	5
* or equivalent	

Communication Skills*	3
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* Public Speaking

* Business Communicaiton

* Personal Computer Application

Course Title: INTRODUCTION TO ENVIRONMENTAL TECHNOLOGY

Catalog Description: (3 Units, No Prerequisites) An overview of the environmental technology area. The effects of hazardous substances on the ecosystem and human health supports the historical perspective of the legislative processes that lead us to all of the current regulations.

Course Title: WASTE GENERATION/REDUCTION/TREATMENT

Catalog Description: (3 Units, No Prerequisites) The study of industrial processes and their generation of waste streams in seven selected industries. The course centers on raw materials and chemicals used in industry, and understanding the material balance concept of inventory.

Course Title: HEALTH EFFECTS OF ENVIRONMENTAL HAZARDOUS MATERIALS

Catalog Description: (3 Units, Has Prerequisite) This course covers the acute and chronic health effects produced by exposure to chemical, physical, and biological agents. Emphasis is on those hazardous materials commonly associated with industrial operations, waste disposal and remediation sites. Routes of entry, risk evaluation, permissible exposure limits, medical surveillance, control methods for reducing exposure, and understanding an MSDS are discussed.

Environmental Technology

Semester Units

Introduction to EHMT	3
Waste Stream Generation/Reduction/Treatment	3
Health Effects of Hazardous Materials	3
Hazardous Waste Management Applications	4
Hazardous Materials Management Applications	4
Safety & Emergency Response	4

Course Title: HAZARDOUS WASTE MANAGEMENT APPLICATIONS

Course Description: (3 Lec./ 1 Lab. Units, Has Prerequisites) This course provides an overview of hazardous waste regulation with an emphasis on generator compliance, site investigation and remediation, permitting, enforcement, and liability. The laboratory portion provides “hands on” application of the regulations.

Course Title: HAZARDOUS MATERIALS MANAGEMENT APPLICATIONS

Catalog Description: (3 Lec./ 1 Lab. Units, Has Prerequisites) A study of the requirements and applications of federal, state and local laws and regulations relating to hazardous materials. The laboratory portion focuses on applications of these laws, as well as planning and reporting functions.

Course Title: SAFETY & EMERGENCY RESPONSE

Catalog Description: (3 Lec./ 1 Lab. Units, Has Prerequisite) This course provides students with hands-on instruction in safety and emergency response to chemical and physical exposures in industrial and field settings. Topics discussed include: hazard analysis, contingency planning, proper use and selection of PPE, site control and evaluation, field sampling and monitoring, and proper use of instruments. This course satisfies the requirements for generalized employee training under OSHA (1910.120).